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BIOLOGY & MEDICINE

1168 Oedema and x-radiation death. Roberts Rugh. AECD-2663, May 1, 1949. Decl. Aug. 1, 1949. 33p.

Embryos of the frog, Rana pipiens, were irradiated with x-rays to 10,000 r, 25,000 r, and 50,000 r at development stages No. 18 - 25 and were followed for developmental sequilae. At these three dose levels the various embryos were all dead by 6, 4, and 3 days, respectively. No embryos, even at the higher levels of irradiation, were killed before 24 hours following exposure. Stages No. 24 - 25 were more sensitive to x-radiation than were stages No. 18 and No. 19, possibly because the excretory and respiratory systems were functioning during these later stages. Growth was impeded at the lower radiation levels and abruptly stopped at the higher levels. Low doses to earlier stages caused uniform and extreme lordosis. Edema occurred at the lower doses in the belly region of the younger (stage 18-20) embryos and in the head region of the older (stage 23-25) embryos. Edema was in regions structurally removed from either the kidneys or the respiratory organs, appearing in the coelom of the earlier stages and in the integument of the later stages. Experimental observations for the various stages are presented in tables and photographs. 15 references.

1169 Biophysics and quantum theory. H. A. Bomke. *Naturw. Rundschau 2*, 49-57(1949) Feb. (in German).

The main problems of biophysics are reviewed with particular reference to the applications of the theory of quantum mechanics and the techniques of nuclear physics in this new field of science. Some of the experimental work and theories, concerned with the fundamental information which can be obtained from studying the action of radiations and particle bombardments upon living cells, are discussed. The production of mutations by such means and the applications of these methods in cancer research are also treated. Recent work on the determination of a quantum-biological reaction in the field of the higher physiological functions of man is discussed and the possibility of a quantum-biological approach to the phenomena of thought and consciousness is noted.

1170 Discussion on the artificial menopause, indications, technique, and complications. *Proc. Roy. Soc. Med. 62*, 311-20(1949) May.

The main topic discussed at the December 17, 1948, joint meeting of the Section of Radiology and the Section of Obstetrics and Gynecology of the Royal Society of Medicine was the following: the production of the artificial menopause by x-radiations in the treatment of functional uterine bleeding. It was pointed out that only in exceptional cases is it permissible to produce the menopause by means of x-rays without a preliminary examination for malignant disease, and that sterilization in the sense of preventing conception should not be confused with the production of menopause. A series of 940 cases is discussed, in which the standard method of inducing the menopause was the irradiation of the ovaries by a single dose of 450 r or by a total of 600 r delivered over two successive days. Conditions necessitating the treatment are tabulated for several series and the use of radium as the castration method is also described.

1171 Effect of environmental temperature on the response of mice to whole-body roentgen radiation. Wille W. Smith, Benjamin J. Highman, J. R. Mitchell, and Henry C. Blount, Jr. *Proc. Soc. Exptl. Biol. Med. 71*, 489-501(1949) July (See also NSA 1-903).

Young male mice were irradiated in groups of 10 with approximately 500 r delivered by a 170-kv machine at a focal distance of 50 cm and a dose rate of 56-64 r per minute, the radiations being screened through 0.55 mm of Al and 0.25 mm of Cu. In the first six experiments, approximately half of the animals were previously acclimatized to the temperature conditions to which they were subjected after the radiations; in the 30°C environment, 46% of those acclimatized died compared to 63% of those not acclimatized, while in the 10°C environment, 52% of those acclimatized died in comparison to 71% of those not acclimatized. Leucocyte counts made on the first and fourth days after irradiation showed no difference attributable to the temperature. In the last three experiments, when the mice were caged singly and thus were unable to huddle together, 69% in the 10°C room died compared with 39% in the 30°C room. The results show that the net effect of a sufficiently cold environment is to lower the resistance of mice to the lethal action of x-rays; subjection to the environment previous to the irradiation favors survival. It was also noted that mice kept in a 30°C environment, which die following irradiation, frequently show fatty changes in the liver.

BIOLOGY & MEDICINE (continued)

1172 The effect of whole body x-irradiation upon the total nitrogen, total protein and refractive index of rat plasma; interim report. James D. Hauschildt and Helen Supplee. Naval Radiological Defense Laboratory Report No. AD-131(B), June 13, 1949. 11p.

A preliminary investigation has been made upon the changes of plasma refractive index, plasma protein, and plasma nitrogen of rats which had received 650 r total body x-irradiation. A marked decrease was found to occur in all cases in the 2 to 4-day post-irradiation period. Refractive index changes paralleled those of protein and total nitrogen in plasma.

1173 Inhibition of plant growth by irradiation. II. Sensitivity and development. Henry Quastler and Marianne Baer. *J. Cellular and Comp. Physiol. 33*, 349-63(1949) July. (See also NSA 1-1244).

A report is presented on the responses to x-irradiations administered to young growth bean seedlings. The concept of radiosensitivity is defined and methods for its calculation are presented in this report. The most sensitive type of response was elicited when the radiation doses were 1,500-3,500 r for the seedlings and were equivalent in their effect to 29,000-66,000 r delivered to dry seeds; the response was characterized by fully developed side roots and a stunted primary root. A series of experiments eliciting the severe reaction type, characterized by delayed primary growth arrest of the root and inhibition of the development of the side roots and the epicotyl, consisted of radiations of 2,500-5,000 r. It was concluded that the growing seedlings are more sensitive to roentgen rays than dry seeds. It was seen that with mild growth inhibition in the roots, the radiosensitivity rises rapidly, before any growth occurs, and reaches a high value; in severe reactions to the roots, the sensitivity rises to a lesser degree. The developmental rise of sensitivity for the hypocotyl and epicotyl is similar to that for the roots.

1174 1948 field results with certain radioactive materials as plant stimulants. U. S. Department of Agriculture Progress Report. May, 1949. 45p. (M-4376).

This report gives the results of the field tests that were conducted during the 1948 crop season. Although these experiments cover only one season, the range of soil types and climatic conditions covered indicate that the experimental results are rather reliable with respect to the materials tested and the method of application used. Three radioactive materials were used in the field experiments. Alphatron (containing Ac and dolomitic limestone), RaBr in dolomitic limestone, and $UO_2(NO_3)_2$. The general conclusion to be drawn from the data is that no effect of the radioactive materials was found, either beneficial or harmful. There are a few cases of differences that reach the 5% level of significance, but they are no more than would be expected from normal distributions.

1175 Radioresistant cells in certain radiosensitive tissues of swine exposed to atomic bomb radiation. John L. Tullis. *Arch. Path. 48*, 171-7(1949) Aug.

A report is presented on the morphological changes noted in the radiosensitive tissues of swine following irradiation. These radiosensitive tissues are the lymph nodes, the bone marrow, the intestinal epithelium, the gonads, the spleen, the thymus, the tonsils, lymphoid aggregations in the bowel wall, and lymphocytes in the peripheral blood stream. After irradiation, the lymphocytes undergo a prompt reduction, rapid lysis in some cases and slow degeneration in others; increased erythrophagocytosis also may occur. In the bone marrow the blast cells are easily destroyed, leaving only the reticular cells intact after heavy irradiation. Complete destruction of sections of the bowel epithelium may occur at random locations after radiation exposure; the fibrocytes and the plasmacytes in the lamina propria are relatively uninjured. After injury to the gonads, no sperm cells are apparent, and few spermatagonia and spermatocytes remain; the cytoplasm of the tubular cells becomes granular and vacuolated, but the indifferent cells which line the tubules next to the basement membrane show no alterations. The developing ova in the ovary show vacuolation of the cytoplasm of the follicular cells and other changes, but the primordial ova are more resistent. It is noted that in these organs discussed, the so-called stem cells (reticular cells, primordial ova, etc.) of the highly radiosensitive organs are comparatively radioresistant; the reason for this is not apparent morphologically.

1176 Toxicity of tellurium. Patricia K. Glass. AECU-374, July 25, 1948. 5p.

Te, chemically related to Se and S, resembles As in its physiological action and has been recognized as an industrial hazard. Physiological results of animal studies and industrial exposures reported in the literature are briefly reviewed. Absorbable salts of Te, and Te-bearing fumes have been found to be actively poisonous. 11 references.

BIOLOGY & MEDICINE (continued)

1177 The biological significance of radiogallium (Ga^{72}). Horace C. Dudley. Naval Medical Research Institute Report No. NM-011-013-Report 6, May 12, 1949. 17p.

Details of preparation of the radioactive sample, shielding and safety precautions, preliminary toxicity data, results of radioautographic studies of skeletal tissues, and a discussion of the biological significance of Ga^{72} are reported. Radioautographic studies have been made showing that this element is deposited throughout all skeletal tissues and especially in those areas of greatest osteogenic activity. Toxicity studies of Ga^{72} indicated that in rabbits the dosage level of of 2 millicuries Ga^{72} per kilogram approaches the acute toxic level. Mice and rats were found to be more resistant to the effects of both radiation and the carrier Ga. On the basis of this work studies have been initiated on the effects of Ga^{72} on osteogenic neoplasms.

1178 Deposition and fate of plutonium, uranium and their fission products inhaled as aerosols. Kenneth G. Scott, Dorothy Axelrod, Josephine Crowley, and Joseph G. Hamilton. *Arch. Path. 48*, 31-54(1949) July.

The purpose of the experiments described was to ascertain the possible hazards resulting from the inhalation of fissionable materials and fission products. With the exception of one study on a human subject, young rats were used for all of the experiments, and after anesthetization, were given Pu, U, and mixtures of fission products containing Sr, Y, Zr, Cb, Ru, Ba, La, Ce, Cs, Pr, Nd, and element 61 in the form of smokes and sprays. The rats were given: plutonium oxide as smoke; plutonium nitrate as a spray; fission products, containing Pu and U, as aerosols; carrier-free fission products aerosols; aerosols of carrier-free Zr or zirconium oxide; and aerosols of Pa as protoactinium oxide. The preparation of the aerosols is given in detail. The zirconium aerosol was administered to both a human subject and the rats. It was shown that the aerosols were almost totally retained by the head and lungs immediately after exposure; after four days the lungs contained the largest percentage of these elements. The elements deposited in the head and the bronchial tree were quickly eliminated through the gastrointestinal tract, while the nonciliated portions of the lungs removed the substances at a slower rate. The main pulmonary site of deposition of the substances was in the bronchial passages and alveoli; a small amount was absorbed and appeared in the skeletal structure, but none was found in the blood vessels or in the lymph nodes.

1179 Deposition of radio gallium (Ga^{72}) in skeletal tissues. H. C. Dudley and G. E. Maddox. *J. Pharmacol. and Exptl. Therap. 96*, 224-7(1949) July (See also NSA 2-68).

The results of a radioautographic study of the distribution of Ga in the skeletal tissues of the rabbit and dog following injections of non-toxic doses of radio-gallium (Ga^{72}) are presented. The radio-gallium was injected as the lactate or citrate into the animals at a dosage level of 0.5 mc/kg of body weight; the animals were sacrificed 12 hr after the injections, and the bones were removed, cleaned of adhering tissue, mounted in dental stone, sectioned, and placed on emulsion x-ray film. The radioautographs show that in young animals the Ga is selectively deposited in the areas of greatest osteogenic activity (the epiphyseal line); in adult animals there is also a deposition in this general area, but it takes place in a more diffuse manner throughout the trabecular bone. The most significant finding is the rapidity of deposition of the Ga.

1180 Distribution of radioactive gallium in the teeth and jaws of experimental animals. J. A. English and H. C. Dudley. Naval Medical Research Institute Report No. NM-008-009-Report 1, May 3, 1949. 14p.

Radiogallium in the form of soluble Ga lactate (pH 7.0 - 7.4) was injected subcutaneously into rats and rabbits. The dosage was 0.2 to 0.4 mc of Ga^{72} per kg of body weight (6 mg/kg), which is well below the toxic level. The animals were killed six hours after injection and thin sections (50 - 100μ) were made of the bone and teeth by cutting with high speed abrasive discs and grinding to the desired thickness against an abrasive wheel. These thin sections were placed next to special x-ray film for 24-48 hr. The rays emanating from the radioactive isotope affected the film just as do the rays from an x-ray tube. The developed negatives were compared with transillumination photographs which were subsequently made from the ground sections. By this means it was determined that radiogallium is predominantly deposited in endosteum, periosteum tooth pulp, and peridontium. There appears to be a moderate deposition in cancellous bone. Cortical bone and the dentin of the root portion of teeth take a barely perceptible amount of radiogallium, whereas coronal dentin and enamel give no indication that any radiogallium is deposited. The main advantages of the autoradiographic method over methods using the electroscope or Geiger counter for determining the radioactivity are that fractional portions of teeth and bone are not required, and the visual localization is rapid and effective. The relative distribution of the radioactive substance in each anatomic area is apparent, however, quantitative measurements were not attempted in this study. 40 references.

BIOLOGY & MEDICINE (continued)

1181 The estimation of radioiodine in the thyroid gland of living subjects. N. B. Myant, A. J. Honour, and E. E. Pochin. *Clin. Sci. 8*, 135-44(1949) No. 1 and 2.

A method is described in which the radioiodine content of a human thyroid can be determined in absolute units from the counting rate given by a Geiger counter opposite the neck, and the position of the center of the thyroid can be calculated by the counting rates at different points from the neck. It was observed that the counting rate was increased about 27% when the thyroid was located in situ; this was due to the back-scattering effect of the radiations.

1182 Cancer of the thyroid. Leonardo Guzman. *Radiology 51*, 820-5(1948) Dec.

The results of the treatment of cancer of the thyroid with radiation and minimal surgery are presented. The x-ray dose given usually consisted of 5,000-8,000 r at 200 kv, through 2 mm of Cu filtration and at a target distance of 50 cm. The doses were delivered through two lateral ports, with dimensions varying according to the mass to be treated, and a central port; the central port recieved 20% of the total dosage while each lateral port received 40% of the dose. Of 22 patients treated in this manner prior to June 1941, 27.7% survived five years or more. Of 12 patients treated by Ra, three were alive after five years. All cases treated were first surgically excised to some degree before radiation therapy. It is concluded that in view of the incidence of cancer of the thyroid in goiter cases, it is advisable to excise all goiters at an early age, unless definitely contraindicated; the treatment of choice for inoperable cancer of the thyroid cases is irradiation by roentgen rays or Ra (6,000-9,000 r being the desirable total dose). It was observed that no cases of myxedema occurred following the therapy.

1183 Cushing's disease--pituitary basophilism. Merrill C. Sosman. *Am. J. Roentgenol. Radium Therapy 62*, 1-32(1949) July.

Seven cases of Cushing's syndrome are presented, six of which are established pituitary basophilism cases. Roentgen irradiation of the pituitary gland was used in the treatment of these cases, and usually consisted of doses of 250-350 r delivered daily to one of two temporal portals, the total dose consisting of 800-1, 500 r or more; the treatments were delivered at 182-200 kv at 40-50 cm distance through 0.5 mm Cu and 1 mm Al filters. Four of the six patients so treated showed effective improvement; one patient had a relapse and died five years later, and one case is too recent to evaluate. The clinical investigation and the diagnostic procedure are discussed and outlined. 72 references.

1184 Endocavitary roentgen therapy. Its application for the treatment of cancer of the uterine collar. L. Mallet and Decker. *Semaine Hopitaux, Paris, 25*, 661-2(1949) Feb. 26 (in French).

This paper was presented at the meeting on January 11, 1949, of the French Society of Electro-Radiology and contains an account of the type of therapy given, the apparatus used (190-kv machine at 50 cm distance) and the effective doses to the different parts of the uterus. Total doses of 6,000-9,000 r are mentioned in connection with irradiations of the vaginal mucosa. Other methods are correlated.

1185 Medullobastoma: nonoperative management with roentgen therapy after aspiration biopsy. C. B. Peirce, W. V. Cone, J. Bouchard, and R. C. Lewis. *Radiology 52*, 621-32(1949) May.

The twist-drill technique for the biopsy of intracranial tumors is discussed and the roentgen ray treatment of patients with medulloblastoma is described. On confirmation of the presence of medulloblastoma a course of radiation is immediately, inaugurated, and usually consists of delivering a total tumor dose of not less than 4,500 r. The radiation source is 200 kv at 50 cm target distance delivered through a Thoraeus filter, producing a beam with a half-layer value of 2.0 mm Cu. Doses of 2,200-2,400 r are usually begun in 100 r doses daily which are increased gradually to 200 r. The results from five patients under eight years of age form the basis of this report. The results are incomplete due to the short time lapse between the treatments and the compilation of the report. The results show that one patient died nine months after the treatments due to a recurrence of the disease, and another patient was alive and apparently well two years after the initial treatments, during which time two subsequent radiation series were given. The reports on the other three patients are incomplete. The immediate results of the treatments showed adjustment to a normal condition for all of these patients within two weeks following the therapy. The author concludes that this therapy should be planned so as to provide "the maximum tolerable dose" within a short period of time after detection of the disease.

BIOLOGY & MEDICINE (continued)

1186 Physical characteristics of soft roentgen rays. E. Dale Trout and R. M. Gager. *Am. J. Roentgenol. Radium Therapy 62*, 91-112(1949) July.

A report of the physical characteristics of the radiation from a roentgen tube having a 2 mm Be-to-air window and operating from 10 to 100 kv (peak) is presented. This report covers the instruments used, failure of the inverse-square law due to air absorption; change in quality due to air absorption at short distances; transmission curves in Be, polyethylene, and Al; and backscatter data and depth dose information for radiation quality from a half-value layer of 0.06 mm of Al to 3.1 mm of Al. It is noted that with unfiltered radiation very little change in quality, backscatter, or depth dose is produced by a change in voltage. A marked difference in quality, backscatter, and depth dose is produced by the addition of a minimum amount of filter. The depth dose information indicates the clinical possibilities of very soft radiation in those conditions where it is desirable to limit the radiation reaching underlying tissues. 11 references.

1187 Treatment of cancer of the penis at the Norwegian radium hospital. Rolf Bull Engelstad. *Am. J. Roentgenol. Radium Therapy 60*, 801-6(1948) Dec.

Primary radiation treatment was used at the Norwegian Radium Hospital for cases of cancer of the penis. The radiations were administered partly be teleradium in doses of 500 γ-roentgens and partly by Ra on a wax cylindrical mold in daily doses of 500-700 γ-roentgens. The usual total dose was 3,500-3,700 γ-roentgens, and for persistent cases higher radiations, electrocoagulation, and amputation of the penis were given. The lymphatic regions were always irradiated regardless of metastases. Of the 37 patients who received the radiation therapy alone, 28 were locally symptom free after treatment.

1188 The treatment of diphtheria carriers with small doses of roentgen rays. J. Th. Van der Werff. *Nederland. Tijdschr. Geneesk. Haarlem 3*, No. 38, 2900-3(1948) (in Dutch).

The x-ray treatment of diphtheria carriers is discussed and the results on 110 patients are presented. It was found that within two weeks after irradiation of 200 r to both lateral fields of the nasopharynx and larynyx (administered on successive days) 90% of the patients were negative. The negative percentage rate without treatment and under the same general conditions is usually 30%.

1189 By-products of atomic energy for use by the pharmaceutical profession. Paul C. Aebersold. Isotopes Branch Circular E-8, nd. 13p.

The uses of radioactive isotopes as therapeutic agents and as tracers in biologicals studies are briefly discussed. Applications in pharmaceutical studies are stressed. Pile production and cyclotron production of radioisotopes are mentioned.

1190 Distribution of C^{14}, administered as $CaC^{14}O_3$, in rat liver glycogen and blood glucose and lactate. George Feil and Victor Lorber. *Proc. Soc. Exptl. Biol. Med. 71*, 452-4 (1949) July.

Pellets of $CaC^{14}O_3$ were implanted intraperitoneally in four unfasted white rats; after seven days the rats were anesthetized, and as much blood as possible was withdrawn and rendered noncoagulable with heparin, placed in stoppered flasks at a constant temperature and agitated for five hours. The blood glucose was converted to the lactate, which was removed, broken down, and measured for activity. The liver glycogen was also isolated and analyzed for activity. A similar isotope pattern was noted for the liver glycogen, and the blood glucose and lactate, and it was concluded that an analysis of the blood glucose and lactate may yield information comparable to that obtained by the degradation of liver glycogen.

1191 Metabolism of I^{131} in severe anoxic anoxia. L. Van Middlesworth. *Science 110*, 120-1 (1949) July 29.

The results of an investigation to determine whether there are any significant alterations in the metabolism of radioactive I in relatively acute exposures to severe anoxic anoxia are presented. Eighteen rats were fed a low I diet for eight weeks, after which one-half were exposed to 268 mm Hg air pressure at 15-20°C for 12 hr, returned to normal pressure and injected with I^{131}. They were then re-exposed to the low pressure for an additional 24 hr and sacrificed. All injections of I^{131} consisted of 10 μc in 0.5 cc of physiological saline solution administered intraperitoneally, and in each rat the total I^{131} was determined in the thyroid gland and in a sample of plasma. The anoxic rats demonstrated a pronounced reduction in protein bound I^{131} in plasma; the influences of anoxia upon the I^{131} in unfractionated plasma, in the thyroid, and in the urine were less pronounced.

BIOLOGY & MEDICINE (continued)

1192 The plasma iodide clearance rate of the human thyroid. N. B. Myant, E. E. Pochin, and E. A. G. Goldie. *Clinical Sci. 8*, 109-31(1949) No. 1 and 2.

Radioactive iodine (I^{131}) was used in experiments on the plasma iodide clearance rates of the thyroids of normal and thyrotoxic patients; the plasma volume clearance was calculated from the measured rate of radioiodide entrance into the thyroid and the simultaneous plasma concentration of radioiodine, through the procedure described. It was found that in normal subjects, the thyroid removes the iodide from about 16 ml of plasma per minute, while the clearance rate for thyrotoxic patients is around 480 ml/min, with individual values in 11 patients of 200-1, 400 ml; the renal clearance rate was about 30 ml/min for both types of subjects. It is concluded that the thyroid clearance rate is a sensitive test for the iodine collecting activity of the thyroid, and may be of great value in diagnosing thyrotoxic cases. 31 references.

1193 Production of radioactive mosquitoes. C. C. Hassett and D. W. Jenkins. *Science 110*, 109-10(1949) July 29.

A method is described for producing readily detectable radioactive mosquitoes by rearing the larvae in distilled water containing P^{32}. The P^{32} was selected because of its convenient half-life and lack of persistent radiation or toxic degradation products. Corrected values for the activities of the mosquitoes, larvae, and solutions are given. Second instar larvae were reared in five solutions of $Na_2HP^{32}O_4$, ranging in strength from 0.05 to 10 μc/ml. All the larvae were greatly retarded in their rate of development, and at higher concentrations pupation did not occur for more than 20 days. At a concentration of 1 μc/ml adults emerged after 15 days and were found to vary in activity from 6,761 to 10,132 cpm. Third and fourth instar larvae were put into a solution containing 10 μc/ml. They developed normally and adults began to emerge on the sixth day thereafter. The radioactivities for the adults are listed. Pupae kept for one day in solutions containing 10 μc/ml were slightly less radioactive than those kept up to three days in the solutions. Another experiment is described which proved that the radioactivity found in the mosquitoes was the result of an actual accumulation of P^{32} by the larvae, and not a contamination of the emerging adults. The results from the series of experiments indicate that highly radioactive mosquitoes can be produced, which lose their radioactivity slowly; the larvae collect the radioactivity rapidly while the pupae accumulate relatively little; both stages do not lose the P^{32} very rapidly.

1194 Radiophosphorus and radiostrontium in mosquitoes. Preliminary report. John C. Bugher and Marjorie Taylor. *Science 110*, 146-7(1949) Aug. 5.

A method is presented for marking aedes aegypti mosquitoes through the use of radioactive tracers (P^{32} in Na_3PO_4 and Sr^{89} in $SrCl_2$ being absorbed in the larval stages in concentrations of 2--16 mμc from larval bath concentrations of 10--20 mμc per cc solution.) Neither isotope was subsequently excreted from the insects; the only significant loss of radioactivity occurred through egg-laying. No toxicity was noticed at concentrations needed for marking, but with concentrations of about 200 mμc per mosquito, egg-laying failure, due to the absence of ovaries, was noted. Females in all cases and concentrations showed twice as much radioactivity as comparable males; experiments demonstrated that the radioactivity was similarly distributed for both of the isotopes tested. The results of four field experiments on the mosquitoes indicate that: mosquito distribution occurs mainly by wind drift; male mosquitoes live only a few days; mortality is higher with rains and high winds; and the radioactivity method is a means of estimating the total area of mosquito population.

CHEMISTRY

1195 The determination of sodium monoxide in sodium. Leonard P. Pepkowitz and William C. Judd. AECD-2660, nd. Decl. July 14, 1949. 15p.

A method is presented for the determination of sodium monoxide in Na. The basis of the procedure is the extraction of the metallic Na with Hg in a special apparatus effecting a quantitative separation from the sodium monoxide. The mean deviation obtained is ±0.02% O. A sampling procedure is described which is an integral part of the method.

1196 An improved method for determination of milligram quantities of vanadium in the presence of uranium. R. H. Gale and Eve Mosher. AECD-2662, nd. Decl. Aug. 3, 1949. 9p.

A rapid, titrimetric method suitable for trace amounts of V in the presence of a large excess of U and with possible presence of Fe, Ti, and Cr has been developed. The method utilizes the reduction of pentavalent V to the vanadyl ion by ferrous ammonium sulfate. The accurate and precise determination of the equivalence point in this titration is made possible by utilization of a modified dead-stop titration apparatus and a micro-weight burette. This method compares favorably in rapidity, ease, and accuracy of results with standard procedures. The method is applicable to any source material containing V and U and may be applied to samples containing no U. One sample may be run several times as only a reoxidation of the V is necessary since the Fe present from the initial titration does not cause trouble. 19 references.

1197 The use of 1,2-cycloheptanedionedioxime as a reagent for nickel. Roger C. Voter and Charles V. Banks. AECU-377, June 30, 1949. 14p.

The water-soluble reagent, 1,2-cycloheptanedionedioxime, reacts with Ni ions to form a yellow precipitate which can be used for the gravimetric determination of this metal. Quantitative precipitation is obtained at pH values of 2.7 and greater. Ni may be determined in solutions containing the following anions: acetate, tartrate, chloride, citrate, perchlorate, sulfate, sulfosalicylate, nitrate, and thiocyanate. Ni is satisfactorily determined in the presence of Al, Cr, Mn, V, Pb, Mg, Zn, Cd, As, Sb, Be, Fe, Ti, Mo, Co, Bi, Cu and in several alloys. A rapid, direct method for determining Ni in steels containing both Co and Cu is described.

1198 Thenoyltrifluoroacetone as a complexing agent for the isolation and purification of carrier-free radioberyllium. Rene A. Bolomey and Leon Wish. AECD-2665, nd. Decl. Aug. 16, 1949. 19p.

Equilibrium and rate studies for the formation and dissociation of the thenoyltrifluoroacetone (TTA) complexes (dissolved in benzene) of Al, Be, Ca, Cu, Fe, Sr, and Y have been reported. Equilibrium studies on the Be chelate based on the reversed reaction gave results that did not agree with those obtained on the forward reaction. Possible explanations for these results have been given. Carrier-free radioberyllium has been successfully separated from most of the other elements studies with TTA dissolved in benzene by adjusting the pH of the extracting medium and by taking advantage of the wide differences in rates of extraction. Co^{56} and Zn^{65}, the only other radioisotopes found in a 200-day-old Li target bombarded with deuterons in a cyclotron, were successfully separated from the Be^{7}. The spectrographic contaminants found were Ca, Mg, Fe, Al, Cu, and Mn, Ca, Mg, and Fe were found in the reagents employed for the separation. With especially purified reagents these elements with the exception of Al should not be present.

1199 The synthesis of choline chloride and acetylcholine chloride labeled in the methyl group with C^{14}. F. Christenson and B. M. Tolbert. AECU-373, July 15, 1949. 6p.

The following outlined experimental procedure was carried out on a semi-micro scale. Methyl iodide was prepared by catalytic hydrogenation of C^{14}-labeled carbon dioxide and iodination with P and I. Yields varied from 80-85%. Choline chloride was prepared by reaction of methyl iodide with β-dimethylamine ethyl alcohol and reaction of the nonvolatile product with silver oxide and HCL. The yield based on methyl iodide was 87%. Acetylcholine chloride was prepared by reaction of anhydrous choline chloride with acetic anhydride. The yield was 42% based on choline chloride.

1200 The application of kinetic theory to the critical curve for aqueous solutions of 1-1 electrolytes. C. H. Secoy. AECU-293, July 27, 1949. 14p.

An equation which gives the relation of critical temperature of aqueous solutions of 1-1 electrolytes to the composition of the solution has been developed by the application of kinetic theory. With the aid of assumptions concerning the types of particles present and their effective radii, this equation has been shown to describe the available data for solutions of NaCl, KCl, KBr, and

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KI. The success in applying the equation does not substantiate the assumptions made but merely demonstrates the applicability of an equation based on kinetic theory. The significance of the numerical values obtained for the equation constants has been discussed.

1201 Basic chemistry of gallium: a study of the chlorogallates August 1, 1947, - June 30, 1949. Henry Taube and Harold L. Friedman. University of Chicago Final Report, nd. 67p. (NP-960).

Observations on the chlorogallates, NH_4GaCl_4, $CsGaCl_4$, $KGaCl_4$, $LiGaCl_4$, and some related compounds are described. These chlorogallates are members of a larger class of compounds of the general formula $M'M'''Cl_4$, in which M' represents a monovalent ion (NH_4^+, alkali metal ion, or others) and M''' represents a trivalent ion (Al^{+++}, Fe^{+++}, Ga^{+++}, Tl^{+++}, or others). For comparison with results obtained with the chlorogallates, experiments have been carried out with the Al and Fe analogues, which are also described in the report.

1202 The condensation of C^{14}-nitromethane with D-arabinose: preparation of 1-C^{14}-D-glucose and 1-C^{14}-D-mannose. John C. Sowden. *J. Biol. Chem. 180*, 55-8(1949) Aug.

A similar article by the author was published in *Science 109*, 229(1949) Mar. 4. It was listed in Nuclear Science Abstracts as Abstract 2-2093.

1203 The preparation of C^{14}-labeled biotin and a study of its stability during carbon dioxide fixation. Donald B. Melville, John G. Pierce, and C. W. H. Partridge. *J. Biol. Chem. 180*, 299-305(1949) Aug.

Biotin labeled with C^{14} in the ureido carbon atom was synthesized from radioactive phosgene and the diamino acid derived from biotin, and the stability of the ureido ring system of biotin during the biotin-controlled fixation of carbon dioxide by Lactobacillus arabinosus was studied. The growth of this organism in the presence of the labeled biotin, under conditions requiring the participation of biotin in carbon dioxide fixation, did not result in any detectable replacement of the C^{14} of the radio-biotin with non-radioactive C. It is concluded that the mechanism whereby biotin promotes carbon dioxide fixation does not involve a transfer of the ureido carbonyl group of the biotin molecule. 16 references.

1204 Preparation and extraction of S^{35}. M. B. Wilk. *Can. J. Research 27*, 475-88(1949) June.

Procedures are described for the preparation and extraction of carrier-free S^{35}, based on the $Cl^{35}(n,p)S^{35}$ reaction. KCl, NaCl, and ferric chloride have been used as target materials. The S^{35} is found to appear in a chemical form which exchanges rapidly with sulfate ion. Separation of S^{35} from irradiated KCl or NaCl is effected by taking advantage of the insolubility of these salts in aqueous HCl solutions. Approximately 99.8% of the salt can be removed while leaving 95% of the S^{35} in solution. Separation from irradiated ferric chloride is effected by solvent extraction of the ferric chloride form aqueous 6-8 M HCl solutions. Less than 0.1% of the total solids is left unextracted. The yield of S^{35} approaches 100%. 17 references, 6 figures, and 5 tables.

1205 A tabulation of general formula for inverse kinetic energy matrix elements in acyclic molecules. J. C. Decius. Brown University Technical Report No. 2 (Office of Naval Research Contract) Mar. 1, 1948. 29p. (NP-818).

In terms of internal coordinates of the bond stretching and bending type, together with a torsional type of coordinate, general formulas for inverse kinetic energy matrix elements have been computed for 33 possible acyclic configurations involving the given types of coordinates. Tabulations are given both for the general case and for three special cases in which all valence angles of the configuration are assumed to be 90°, 109°28′, and 120°, respectively.

1206 An instrument for rapid determination of crystal orientation. R. H. Gillette and M. H. Jellinek. *Rev. Sci. Instruments 20*, 480-3(1949) July.

The rapid orientation of crystals can be accomplished by the use of an apparatus employing a Geiger counter and x-ray focusing. The instrument can be used for precise orientation or to sort samples into various tolerance ranges. Applications to sapphire are discussed in detail. The instrument has also been used in connection with rutile and Ba titanate orientations.

CHEMISTRY (continued)

1207 Spectrophotometric studies of beryllium thenoyltrifluoroacetone. Leon Wish and Rene A. Bolomey. AECD-2669, nd. Decl. Aug. 16, 1949. 13p..

Beryllium thenoyltrifluoroacetonate, $Be(TTA)_2$, has been found to exist in two forms with different spectral curves. The A form reported by Zebroski, U. of California Report (1947), has an absorption maximum located at 349 mμ. The B form has either a maximum at 365 mμ or two maxima, one located at 349 and one at 365 mμ. The A form was found to be easily transformed into the B form with either a weak alkali wash or by sublimation at 60-80° and 12-18 mm mercury. So far it has not been possible to convert the B form into the A form nor has it been possible to fractionate the double-banded spectrum of the B form into two components.

1208 The polarographic behavior of the neptunium (III) - neptunium (IV) couple in chloride and perchlorate solution. J. C. Hindman and Evelyn S. Kritchevsky. AECD-2658, June 1949. Decl. July 28, 1949. 12p.

Polarographic measurements have been made of the Np(III)-Np(IV) couple in perchloric and hydrochloric acids. The couple is polarographically reversible in hydrochloric acid giving an oxidation potential for the reaction $Np(III) \rightleftarrows Np(IV) + e^-$ of -0.142 ± 0.005 volts. The hydrogen ion independence of the couple between 0.1 and 1.0 M hydrochloric acid is interpreted as supporting the conclusion that the Np(III) and Np(IV) ions are Np^{+3} (hydrated) and Np^{+4} (hydrated) in non-complexing acid media. The Np(III)-Np(IV) couple is polarographically irreversible in perchloric acid. The difference in polarographic behavior of the tri-positive and tetra-positive ions of Np and U in perchlorate media is discussed.

1209 The actinide series and the periodic table. Zoltán Szabó. *Phys. Rev.* 76, 147-8(1949) July 1 (Letter to the editor).

Chemical investigations are discussed which are of interest with respect to the reports of various investigators which tend to corroborate the similarity between the transuranic elements and the rare earths. The variation in specific weight, melting point, and ionization potentials of the elements involved are discussed; these lead the author to conclude that Th, Pa, and U as well as Np and Pu can by no means be considered as higher homologues of the Ti, V, Cr, Mn groups, respectively, of Ru and Os. They are members of the Al group just as well as the lanthanides. In the arrangement suggested, Th, U, Pa and the transuranic elements are inserted into a group starting with Ac, since the physical and chemical properties of the elements fit into the character of the third column of the periodic table. According to this grouping of these elements the arrangement of the electrons can be assumed in the following manner: the 6d level possesses only 1 electron at Ac, the next electron of Th, however, is bound in 5f orbit, which further will be filled at Pa by 2, at U by 3 electrons. Thus the higher homologues of La, Ce, Pr, and Nd are Ac, Th, Pa, and U just as Il and Sm are the foregoing elements of Np and Pu.

1210 The infrared spectra of the acetylacetonates of uranium, thorium, iron and magnesium. H. W. Morgan. AECD-2659, May 6, 1949. Decl. July 28, 1949. 16p.

The work described was undertaken to determine the vibration frequencies associated with the U-O bonds in the uranous acetylacetonate complex. The spectra of the U, Th, Fe, and Mg acetylacetonate complexes, and of acetylacetone, are traced and compared. By comparison of these five spectra, the bands in the complexes due to the acetylacetonate group are recorded. Assuming that the uranous and thorium complexes have the same type of structure, comparison of these two spectra with each other and with the spectra of the Fe and Mg complexes allows selection of the U-O frequencies.

1211 Spectrophotometric determination of uranium using hydrogen peroxide and alkali. A. A. Smales and E. Furby. Atomic Energy Research Establishment Report No. AERE-C/R-344, April 1949. 16p.

The spectrophotometric determination of U using hydrogen peroxide in alkaline solution is discussed with emphasis on the effect of pH and the relative sensitivities obtainable with a Hilger Spekker Absorptiometer, and a Beckman Spectrophotometer. It is shown that pH variations have a marked effect, and that for best results it is desirable to work at pH > 12, while, as might be expected, the relative sensitivities of the two instruments are almost identical under similar conditions. The use of the Absorptiometer as a monochromatic instrument, particularly at 365 mμ, is discussed, and it is shown that amounts of U as small as 50-1000 μg may readily be determined using this instrument and a 4cm cell.

CHEMISTRY (continued)

1212 Method of preparing uranium trioxide. Sherman M. Fried, and Norman R. Davidson (to the U. S. A. as represented by the U. S. Atomic Energy Commission). U.S. 2,477,924, Aug. 2, 1949.

A process for the preparation of uranium trioxide (UO_3) in crystalline form from an amorphous oxide of uranium (U_3O_8) is described. This is accomplished by heating the amorphous oxide between 450 and 750°C under oxygen pressures varying from 20 to 150 atm. The time required for the conversion varies from 12 to 112 hr depending upon the pressures and temperatures to which the system is subjected. This time can be reduced to 1½ to 2 hr by using oxygen pressures between 60 and 150 atm at a temperature from 700 to 750°C. A description of the apparatus for the preparation of uranium trioxide is given.

ENGINEERING

1213 Cadmium trap for arresting mercury vapor. T. Wilner. *Rev. Sci. Instruments 20*, 527 (1949) July (Laboratory and shop notes).

It is suggested that the disturbances due to oxidation, which are produced if alkali metal traps are used in connection with producing high vacua, can be eliminated by substituting Cd for the alkali metal. A simple trap of this type, which has been used successfully, is shown. The trap acts as a getter for Hg forming a low vapor pressure amalgam, and possibly may act as a getter for other materials as well.

MINERALOGY, METALLURGY AND CERAMICS

1214 Specific heat of beryllium between 0°C and 900°C. D. C. Ginnings, T. B. Douglas, and Anne F. Ball. AECD-2657, June 16, 1949. Decl. July 25, 1949. 13p.

Using an ice calorimeter and furnace of improved design, the specific heat was determined on two samples of Be by measuring the changes of enthalpy between 0° and 900°C. Both samples were more than 99% pure, and additive corrections were applied for the impurities present. Although one sample contained 0.4% of Mg and the other almost none, the specific heat values found for the two samples differed by less than 1% at every temperature investigated, a result in sharp contrast to the variations of up to 25% found by other workers for various samples of Be of purities comparable to those of this investigation. Sources of error in the values obtained are examined.

1215 Interchange interaction and collective electron ferromagnetism. E. P. Wohlfarth. *Phil. Mag. 40*, 703-17(1949) July.

A preliminary discussion is given of the interchange interaction energy terms occurring in the collective electron treatment of ferromagnetism. The theoretical background is outlined and the relevant energy terms calculated for free electrons. It is shown that, if the interchange interaction energy for anti-parallel spins is taken into account qualitatively, the total energy may vary as the square of the magnetization, as is assumed in Stoner's statistical treatment. Application to electrons in actual metals will require some very complicated calculations; a brief outline is given of the three main approximation methods which may be used. Valuable information may, however, be obtained by careful analysis of experimental results; a possible explanation may, for example be given of the discrepancy between the calculated and observed magnetization, temperature curve of nickel. It is finally suggested that the collective electron treatment provides a much more satisfactory approach to the problems of ferromagnetism than the Heitler-London-Heisenberg method. 28 references.

1216 Investigation of possible improvements in the production of zirconium metal; report no. 1, July 1 to July 31, 1949. Stephen M. Shelton. Bureau of Mines Metallurgical Division. July 31, 1949. 11p. (NP-977).

The subject of this report refers to improvements of the present Zr reduction process. This process consists of reducing purified gaseous zirconium chloride with fused Mg under a He seal, and separating the magnesium chloride produced from the Zr sponge by heating the reaction mixture to elevated temperatures in a vacuum. A water-cooled bolted flange-type lid on the reaction furnace was used instead of the Pb seal type arrangement. A small lead seal type valve built into the lid is retained for venting purposes. Direct, in place, H treatment of the crude zirconium chloride in the purification vessel was found to be effective for Fe removal in a number of small scale experiments. The reaction of fused mixtures of Na and Mg with gaseous purified zirconium chloride that has been passed through heated pipes was smoothly and safely completed.

MINERALOGY, METALLURGY AND CERAMICS (continued)

A series of fused Na-Mg mixtures were reacted with zirconium chloride to test the limits of Na addition consistent with safe operation. Mixtures of 80% Na, 20% Mg gave no indication of free Na in the end products after reaction with zirconium chloride and salt removal. Various crucible materials were tested to determine their resistance to the alloying action of Zr.

1217 Quantitative treatment of the creep of metals by dislocation and rate-process theories. A. S. Nowick and E. S. Machlin. National Advisory Committee for Aeronautics Report No. NACA-845, Jan. 1, 1946. 10p.

An equation for the steady-state rate of creep has been derived by applying the theory of dislocations to the creep of pure metals. The form of this equation is in agreement with empirical equations describing creep rates. The theory was also used to predict the dependence of steady-state rate of creep on physical constants of the material and good agreement was obtained with data in the literature for pure annealed metals. The rate of creep was found to decrease with increasing modulus of rigidity. This relation suggests that one of the requirements for a heat-resisting alloy is that its matrix be a metal that has a high modulus of rigidity and, therefore, a high modulus of elasticity.

PHYSICS

1218 Lead brick for shielding. Luther E. Preuss. *Rev. Sci. Instruments 20*, 534(1949) July (Laboratory and shop notes).

Interlocking lead bricks of tongue and groove design suitable for use in shielding have been developed to overcome the usual deficiency of shielding bricks, i.e., a tendency to tip when stacked and the development of fissures between bricks after brief usage through which dangerous radiations may escape. Dimensioned working drawings of the four brick-types which have been used are shown.

1219 Proton range-energy relation. R. L. Clarke and G. A. Bartholomew. *Phys. Rev. 76*, 146(1949) July 1 (Letter to the editor).

The results of cloud chamber determinations of points for the proton range-energy relation at low energies are reviewed. The data favors the curve of Livingston, et al, *Rev. Mod. Phys. 9*, 245(1937), although there is some indication that this curve may be about 20 kv low in the region of 0.5 Mev.

1220 Proton stopping power of gold. Torben Huus and C. B. Madsen. *Phys. Rev. 76*, 323 (1949) July 15 (Letter to the editor).

The previously reported measurements of the proton stopping power of Be, Madsen et al, *Phys. Rev. 74*, 648(1948), have been extended to Au, using the proton resonances F-339 and Al-986 as energy indicators. A foil thickness of about 1/2 mg/cm^2 was chosen for the experiment in order to obtain a shift of the resonance peaks of approximately three times the half-width calculated from the theory of straggling. Tabulated data are given for three different foils. The values for stopping power of Au at proton energies of 364 kev and 366 kev were found to be 85 kev per mg/cm^2 and 81 kev per mg/cm^2, respectively.

1221 Resonance scattering of protons by aluminum. R. S. Bender, F. C. Shoemaker, S. G. Kaufmann, and G. M. B. Bouricius. *Phys. Rev. 76*, 273-6(1949) July 15.

The elastic scattering of protons by Al at energies near the 985 kev (based on the 440 kev Li(p,γ) voltage scale) resonance has been studied, with the use of the homogeneous proton beam available from the Wisconsin pressure generator equipped with the 90° electrostatic analyzer. The variation in the scattering yield with proton energy agrees qualitatively with the prediction of the Breit-Wigner formula. On the assumption of S-scattering, the data indicate a natural resonance width of the order of 100 v.

1222 Straggling of electrons near the critical energy. L. Eyges. *Phys. Rev. 76*, 264-9(1949) July 15.

The straggling of electrons caused by loss of energy by radiation and collision is discussed. The diffusion equation is considered and straggling, both with and without collision loss, treated. The "straggling probability" for an electron that loses energy by radiation only (i.e., without collision loss) is found and curves corresponding to various approximations to the expression for the radiative cross section are obtained. Taking the collision loss also into account, a formal expression for the straggling probability is found in the form of a series in which the terms

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decrease rapidly for energies which are not too small and for not too great a thickness. No proof of the convergence is given however; and, in fact, for very small energies the terms increase and some higher order terms become infinite at zero energy. Some remarks are also made on the small "showers" initiated by a particle of energy near the critical energy.

1223 The half-life of the positive π meson. E. A. Martinelli. AECU-387, nd. 1p.

This document is in abstract form; it is reproduced below in its entirety.

Data for the half-life of the positive π meson has been obtained using essentially the method employed by Richardson, *Phys. Rev.* 74, 1720(1948), for the determination of the half-life of the negative π meson. This consists of determining the decrease in number beyond geometrical factors of the mesons reaching 180° and those which reach 540° or 900° from the target. Simultaneous exposure of plates at 180° and at one of the other positions is accomplished by utilizing the helical paths of the mesons in the nearly uniform field of the cyclotron. The mesons are produced by proton bombardment of a carbon target in the 184-in. cyclotron. Several refinements in the method have been introduced which will enable the geormetry of the apparatus to be determined to a higher degree of accuracy, and also a third point on the decay curve will be determined. Preliminary scanning of the plates shows a half-life in agreement with that of Richardson, within the statistics of track counting.

1224 Yield of negative π mesons produced by high energy protons as a function of proton energy. Stanley B. Jones and R. Stephan White. AECU-390, nd. 1p.

This document is in abstract form; it is reproduced below in its entirety.

A study is now in progress to find the relative numbers of negative π mesons created by protons of various energies. The energies were obtained by placing the targets at different radii in the 184-in. Berkeley cyclotron. The study is limited to star producing mesons with energies of approximately 2-6 Mev emitted within ± 45° of the forward direction from a 1/32-in. carbon target. Eastman type NTB Plates were used to record the mesons.

Preliminary data is given in the table. Column 1 gives the energy of the bombarding protons; column 2, the numbers of mesons actually counted; and column 3, the numbers of mesons relative to the number at 340 Mev, corrected for beam current, plate thickness, and area scanned.

Beam Energy (Mev)	No. of Mesons	Corrected Relative Yield
340	22	100 per cent
306	41	43 " "
272	22	27 " "
238	5	5 " "
204	2	1 " "
170	0	0 " "

1225 Capture of negative mesons. R. Huby. *Phil. Mag.* 40, 685-98(1949) July.

The time taken for a negative meson, stopping in a solid, to reach its lowest Bohr orbit about a nucleus, is discussed, with special reference to the possibility of "trapping" for a long time in a bound orbit in insulators. It is shown that there are more ways in which this can happen than are dealt with in Fermi and Teller's discussion, *Phys. Rev.* 71, 314(1947), and an approximate calculation is made of the time spent in a trap. The results are consistent with the experimental observations on π and μ mesons. For heavy mesons (mass ~ 900 m_e), the time of approach to a nucleus is found to be normally $10^{-13} - 10^{-12}$ sec, but trapping of mesons may be expected in certain circumstances for times up to 10^{-5} sec.

1226 Comment on the nuclear capture of negative mesons. J. Barnothy. *Phys. Rev.* 76, 303 (1949) July 15 (Letter to the editor).

It is suggested that the absence of the normal decay process when negative mesons are stopped in an element of high atomic number may be attributed to the fact that no decay will occur whenever the electron does not obtain energy sufficient for leaving the K-shell. Such cases might be erroneously interpreted as nuclear captures without star-production at the end of the track, which is difficult to explain. Although it is difficult to say whether the process occurring is an apparent lifetime shortening of the negative mesons with a nuclear capture or whether it is a true decrease of the lifetime in the K-shell, the author concludes that the absence of decay electron tracks from Pb can no longer be considered as a proof in favor of the nuclear-capture conception.

PHYSICS (continued)

1227 The absorption of negative π-mesons by protons. R. E. Marshak and A. S. Wightman. *Phys. Rev.* 76, 114-7(1949) July 1.

The lifetime for absorption of a π^--meson by a proton, leading to the emission of a high energy photon, has been calculated. Calculations have been performed for both scaler and pseudoscalar π^--mesons and for absorption "on the fly" and from bound states. The lifetimes from bound states are extremely short compared to the time for decay into μ^--mesons. The competition between π^0-emission and γ-emission is considered and inverse processes are also discussed.

1228 Angular distribution and multiplicity of neutrons associated with local cosmic-ray showers. G. Cocconi and V. Cocconi Tongiorgi. *Phys. Rev.* 76, 318-9(1949) July 15 (Letter to editor).

Preliminary experiments have been performed at 260 m to study some aspects of the local production of neutrons associated with local showers of ionizing particles. The following topics have been investigated: (a) angular distribution of neutrons, and (b) multiplicity of the neutron production in Pb. Tabulated results of the coincidence measurements are given.The results indicate that the neutrons are produced fairly isotropically confirming the previous suggestion, *Phys. Rev.* 74, 1867(1948), that the observed neutrons are produced in evaporations of excited nuclei. The results obtained are interpreted and it is noted that if the primary act induces further evaporations, the radiations that cause them have very short mean free paths.

1229 Cosmic ray studies; biennial report July 1, 1947 - June 30, 1949. Princeton University Technical Report No. 2. June 30, 1949. 124p. (NP-959).

The report summarizes work in the field of cosmic ray and elementary particle physics carried out in the past two years. The work falls into four main divisions: studies of the primary cosmic radiation incident on the earth; investigation of the relations between the nucleonic components of the cosmic radiation – stars, protons, neutrons; experiments on the decay and nuclear reactions of mesons; and theoretical interpretation of the three types of experiments. The discovery of characteristic gamma radiation released when negative mesons react with atomic nuclei; evidence for a multiplication of the nucleonic component in the upper atmosphere; evidence that energetic secondaries follow the direction of the primaries that produce them; determination of the absolute neutron intensity in the atmosphere; and establishment of an empirical triangle relation between the coupling constants for three experimentally quite different types of elementary particle reactions are designated as being of special interest. A crystal counter for fractional μ-sec timing in decay and for ionization measurements, a combination cloud-and-ionization chamber for nuclear star studies, and a parallel plate counter stack to combine ultra short time measurements with the advantages of cloud chamber observations are pointed out for special attention.

1230 The flux of heavy nuclei of the primary cosmic radiation at geomagnetic latitudes $\lambda = 55^\circ$ and $\lambda = 30^\circ$. H. L. Bradt and B. Peters. *Phys. Rev.* 76, 156-7(1949) July 1 (Letter to the editor).

Approximately 200 tracks of cosmic ray primaries, with atomic numbers in the range $Z = 2$ to $Z = 26$, have been analyzed by the methods previously described. The tracks were obtained in a stack of 58 specially prepared Eastman NTB plates (3in.x 20 in.) at a geomagnetic latitude $\lambda = 55^\circ$N and at an altitude of 97,000 ft. Accurate determinations of the range and the energy were made for 30 particles which stopped in the stack. Curves of the kinetic energies of these particles as a function of the atomic number are shown as well as the frequency distribution of these tracks as a function of the energy per nucleon. The minimum energy observed of 0.37 Bev/nucleon is equal to the geomagnetic cut-off energy at geomagnetic latitude $\lambda = 55^\circ$N. The flux of nuclei of the C, N, O group at the top of the atmosphere was determined as $I_{c,n,o}(55^\circ) = (4.0 \pm 0.5)10^{-4}$ (nuclei/cm^2 sec steradian. For heavier nuclei, i.e., $Z > 10$, $I_{Z>10}(55^\circ) = (1.4 \pm 0.4) \times 10^{-4}$ (nuclei/cm^2 sec steradian. Data taken at $\lambda = 300$ (altitude of 93,000 feet) indicate that the intensity of heavy primaries is reduced only by a factor 1.5, or at most 2, between $\lambda = 55^\circ$N and $\lambda = 30^\circ$N, i.e., the latitude effect is smaller than would be expected. It is concluded that (1) if one assumes that the C, N, O nuclei are completely stripped of electrons before entering the earth's magnetic field it appears that this field alone determines the lowest energy with which particles enter the atmosphere even at magnetic latitudes as high as 55° N, and (2) The great majority of heavy primaries have energies far in excess of the geomagnetic cut-off energy at $\lambda = 55^\circ$ N. For these the energy loss per mean free path is small compared with their initial energy and hence, they will lose most of their energy in nuclear collisions. They, therefore, produce effects also on the secondary radiation observed at lower altitudes.

PHYSICS (continued)

1231 On the interaction between mesons. H. Y. Tzu. *Phil. Mag. 40*, 717-32(1949) July.

The interaction between mesons transmitted by the sea of nucleons in negative energy states is investigated. For low energy mesons, the interaction appears as terms added to the Lagrangian for the meson field in vacuo. Weisskopf's method, *Det. Kgl. Dan. Vid. Sel. Mat. Fys. 14*, 6(1936), fails to give the coefficient of the term depending on the fourth power of the field strength, which is mainly responsible for the scattering of mesons by mesons. Instead, the subtraction method of Dirac, *Cambridge Phil. Soc. Proc. 30*, 150(1934), and Heisenberg, *Z. Physik. 90*, 209(1934), is used. The range of the interaction is found to be the Compton wavelength of the meson and the singularity at small distances is of the type R^{-5}. The total cross-section for the measuring of mesons by mesons is of the order 10^{-29} cm^2 and the existence of a closed stationary or quasi-stationary assembly of mesons is unlikely.

1232 A large nuclear disintegration produced by a very high energy alpha-particle of the cosmic radiation. J. J. Lord, Marcel Schein, and M. Vidale. *Phys. Rev. 76*, 321-2(1949) July 15 (Letter to the editor).

An event observed on an Eastman NTB-3 photographic plate is described which has been interpreted as the collision of a primary α-particle of several Bev energy with a nucleus in the emulsion, with the subsequent emission of several charged nucleons of energies estimated to be from 4 to 200 Mev and the production of a low energy π-meson.

1233 Magnetic deflection of cosmic-ray mesons using nuclear plates. Ian Barbour. *Phys. Rev. 76*, 320-1(1949) July 15 (Letter to the editor) (See also NSA 1-994).

Using a previously described method, Barbour, *Phys. Rev. 74*, 507(1948), in which two nuclear plates are exposed with an air gap separating their parallel emulsion surfaces, in a perpendicular magnetic field, data was obtained on the magnetic deflection of cosmic ray mesons. The measurements were made in two balloon flights at 90,000 ft, for 1 hr with 100-μ emulsions, and for 3 hr with 200-μ emulsions. A magnetic field of 13,3000 gauss was used and the plates were of the Ilford C2 type. Preliminary measurements were obtained on 33 mesons. There is confirmation of the positive charge of π and μ -mesons, and the negative charge of σ(star-producing) mesons, concerning which there is no possibility of direct evidence on cosmic-ray mesons from other emulsion techniques. σ-mesons appear about equally divided between + and −. From the data, $M_\pi = 219 \pm 26$ and $M_\sigma = 270 \pm 23$. There is no evidence in these experiments so far for the presence in appreciable abundance of "heavy" mesons, which could usually be differentiated from protons if they were negative or interacted visibly. The possible presence of "light" mesons cannot be excluded, as several "unmatched" tracks were observed.

1234 Mean life considerations in relation to curvature of cosmic-ray paths in a magnetic field. W. F. G. Swann. *Phys. Rev. 76*, 157-8(1949) July 1 (Letter to the editor).

An expression is obtained relating the mean life of the cosmic rays (in a pencil of rays having a specified energy range) to the angular deviation experienced by the rays subsequent to their origin. It is found that

$$m_0 \tau \beta / \tau_0 \rho = He/c^2$$

In which $\beta = v/c$, τ is the mean life of the particle at the instant that it is travelling in the element dx, τ_0 is the rest mean life, H is the magnetic field and $m/m_0 = \tau/\tau_0$.

1235 On the penetrating component of cosmic ray air showers. Frank L. Hereford. *Phys. Rev. 76*, 142-3(1949) July 1 (Letter to the editor).

Experiments have been made to detect the heavy particles associated with extensive showers, recently described by Cocconi, et al, *Phys. Rev. 75*, 1063(1949), which are capable of penetrating 17.5 cm of Pb and are thereafter absorbed slowly with a mean range of 3,600 g/cm^2 of Fe. The counting efficiencies of trays of low pressure (12 mm of Hg) and high pressure (90 mm of Hg) Geiger-Müller counters under 18.5 cm of Pb (200 g/cm^2) were determined for single penetrating shower particles. The results obtained indicated that the penetrating shower particles have essentially minimum ionization. It is noted that there is an apparent decrease in the overall efficiency of both the high and low pressure counters for the penetrating shower radiation relative to that for the total radiation.

PHYSICS (continued)

1236 Polarization of mesons produced at threshold in gamma-nucleon collisions. Daniel B. Feer. *Phys. Rev. 76*, 306(1949) July 15 (Letter to the editor).

The polarization of mesons produced in γ-nucleon collisions, as from the γ-ray beam from a synchrotron, has been examined. The ratio of the cross sections for production of longitudinal and transverse mesons has been calculated at exact threshold, taken to be mc^2 (m = π-meson mass) since terms of order m^2/M^2 (M = nucleon mass) are neglected. The results are as follows:

Field	Coupling	Cross section ratio
Vector	Vector	0
Vector	Tensor	0.4
Pseudovector	Pseudovector	∞
Pseudovector	Dual-tensor	0

The results are interpreted and it is noted that the following four processes could account for the difference between the vector and pseudovector fields: a direct interaction coupling the four particles involved, and three others involving the creation of virtual mesons or nucleons and the absorption of the photon. It is thus possible to produce near threshold a beam of polarized integral-spin mesons by the synchrotron γ-ray beam. Since there appear to arise no new depolarizing effects other than those discussed by Wentzel, *Phys. Rev. 75*, 1810(1949), and since the experiment can be performed outside the tank, thereby eliminating the effect of magnetic fields on Wentzel's experiment, it seems that such an experiment might give useful information on the π-meson spin.

1237 Positive excess of mesons at 30,000 feet. Marcello Conversi. *Phys. Rev. 76*, 311-2 (1949) July 15 (Letter to the editor).

In a series of B-29 flights undertaken at different altitudes and latitudes, experiments with Geiger counters in delayed coincidence have been carried out to investigate the composition of ionizing cosmic rays slowed down after traversing a certain thickness of Pb. Preliminary results concerning the excess of positive mesons are reported. Decay curves of mesons slowed down in graphite and S are shown and tabulated data on the coincidence measurements are given. Values of 21.5%, -1%, and 42% have been obtained for the positive excess at altitudes of 600 ft, 2,100 ft, and 30,000 ft, respectively.

1238 Production of meson showers. W. Heisenberg. *Nature 164*, 65-6(1949) July 9 (Letter to the editor).

Calculations are made on the recent experimental data on mesons, Brown et al, *Nature 163*, 47(1949) and Clay, *Physica 14*, 495(1948), Meyer et al, *Phys. Rev. 74*, 846(1948); the old theory is applied in which it is assumed that in a very energetic collision of two nucleons a large part of the kinetic energy available in that frame of reference in which the center of gravity is at rest ("c-system") will be turned over to the meson field. In the meson field a turbulent process will go on in which this energy is dissipated with the isotropic production of many mesons in the "c-system." From calculations of the average number of mesons produced, and of the average kinetic energy left to the nucleons after collision, it is concluded that the number of mesons varies roughly as the square root of the primary proton energy. If the symmetrical theory of nuclear forces is correct, only two-thirds of the π-mesons should be charged. Also, the frequency of showers with more than the average number of mesons, n, should decrease roughly as $(n \ln n)^{-3.4}$. Expressions are obtained for the differential distribution of mesons and, by integrating, for the energy-spectrum of the π-mesons in the shower. The maximum intensity is found to lie at about 400 Mev, or for showers containing n mesons, at 65n Mev. Expressions are also given for the energy distribution, at high energies, of the μ-mesons, and for the positive excess of all μ-mesons above the value for the maximum intensity. The result obtained for the latter is in agreement with the experimental results reported by Bernardini, *Phys. Rev. 71*, 209 (1947).

1239 Production of π-mesons by high energy nucleons. E. Strick and D. ter Haar. *Phys. Rev. 76*, 304(1949) July 15 (Letter to the editor).

An expression for the cross section for the production of π-mesons by bombardment with high energy nucleons is obtained using the Weiszäcker-Williams method and performing the third-order perturbation calculations. The resulting expression is identical with that obtained by Wang, *Z. Physik 115*, 431(1940), and hence does not agree with that of Urban, et al, *Acta Phys. Austriaca 2*, 368(1949).

PHYSICS (continued)

1240 The production of mesons by photons and electrons. Herman Feshbach and Melvin Lax. *Phys. Rev.* 76, 134-5(1949) July 1.

Calculations are given on the production of pseudoscalar and vector mesons by photons and electrons. The recent laboratory production of π-mesons by electromagnetic means makes a comparison with the predictions of various meson theories feasible. Curves are given for the total cross section and the angular distribution for the production of mesons by photons. It is noted that there occurs only a relatively slow variation in cross section for the production of pseudoscalar mesons for $\mu = 300\ m_e$, whereas there is a large and rapid increase of cross section for the vector meson. For production of vector mesons the rapid increase of the cross section for production by photons with increasing photon energy make the close collisions between electron and nucleon important. The modified Weiszäcker-Williams method, *Phys. Rev.* 73, 1271A(1948), has hence been applied. By this means a lower bound to the cross section, which increases logarithmically with electron energy for pseudoscalar meson production, is obtained, while for the vector meson, the energy dependence is considerably stronger than quadratic. In addition, the magnitude of the cross section for electron production of mesons is reduced relative to the cross section for photon production by the factor $2e^2/\pi \sim 1/215$. The significance of these calculations with respect to a satisfactory theory of the fundamental properties of mesons and of their interactions with nuclei is discussed.

1241 Radiation accompanying meson creation. L. I. Schiff. *Phys. Rev.* 76, 89-93(1949) July 1.

The amount and character of the electromagnetic radiation expected to accompany the creation of charged mesons in nucleon-nucleon collisions is calculated for mesons of spin 0, $1/2\hbar$, and $\hbar$, in each case with the normal magnetic moment. The ratio of radiated energy to initial meson energy increases logarithmically for high meson energy in the first two cases, and is of the order of 1% for the highest energies of interest in studying cosmic radiation. For vector (spin $\hbar$) mesons, this ratio is $(11\alpha/4860\pi)(E/mc^2)^4$ in the relativistic region, where α is the fine-structure constant, and m and E are the rest mass and the initial energy of the meson in the coordinate system in which the center of mass of the colliding nucleons is at rest. This is so large at high energies that the assumption that π-mesons have spin $\hbar$ would, with a plausible theory of the multiplicity of meson production, account for the observation of soft radiation in conjunction with energetic nuclear events.

1242 Spontaneous decay rate of heavy mesons. L. I. Schiff. *Phys. Rev.* 76, 303-4(1949) July 15 (Letter to the editor).

Assuming that π-mesons are scalar particles, that μ-mesons, electrons, neutrinos (ν), neutrons (N), and protons (P) are all Dirac particles, and that all couplings are of the scalar type that involve the Dirac β-operator, the following expression for the reciprocal mean life for decay of a π-meson is obtained:

$$\frac{1}{\tau_\pi} \frac{G^2 g^2 p^2}{2\pi^5 m\hbar^8 c^3} \left| \int_0^\infty \frac{P^4 dP}{(P^2 + M^2 c^2)^{3/2}} \right|^2$$

in which m is the mass of the π-meson, p is the momentum of the emitted neutrino, M is the mass of the nucleon, and the integration is carried over all intermediate nucleon momenta P. The formula gives $1/\tau_{\pi\mu}$ or $1/\tau_{\pi\epsilon}$ according to whether g is given the value g_μ or g_ϵ. If the self-energy of the π-meson at rest is set equal to mc^2 and g_μ is taken as 10^{-49} erg-cm^3 in order to obtain agreement with the rate of nuclear capture of negative μ-mesons, a value of $\tau_{\pi\mu} = 2.3 \times 10^{-9}$ sec is obtained. This is in fair agreement with the observed value. The results obtained seem to indicate that the rate of nuclear β-decay is too large to be consistent with the small rate of $\pi - e$ decay, if either $\pi - e$ coupling or nucleon-electron coupling is assumed by itself.

1243 Variation of meson intensity with height. P. H. Barker. *Phys. Rev.* 76, 141-2(1949) July 1 (Letter to the editor).

Flights have been made with an airborne cosmic ray recorder at a magnetic latitude of 45°S; the array used was similar to that used by Bhabha et al, *Phys. Rev.* 68, 147(1945), the Pb absorber consisting of 5.25 cm of Pb. However, in filling the counters, ether was used as a quenching gas to improve the low temperature performance. A plot of the logarithm of the number of counts per minute (attributed to mesons penetrating 5.25 cm. of Pb) as a function of the pressure in millibars resulted in the following relationship:

$$\log_{10} \text{C.P.M.} = -1.87 \log_{10} P_{mb} + 5.53,$$

The results obtained are compared with those of Bhabha and Gill, *Phys. Rev.* 71, 82(1947). It is concluded that it is probable that there is a change of latitude effect with height which is in the range 0-11%.

PHYSICS (continued)

1244 Motorized rod runner CS-1158. Donald F. Uecker. AECU-290, June 1, 1948. 6p.

This report describes the function and operation of the motorized rod runner, a device designed to provide a small, versatile unit, capable of producing thrusts up to approximately 10 pounds along a grooved rod of any practical length. The rods, which are preferably not over 36 in. long, may be clamped in ordinary chemist's framing or held in a rotating ring stand base, to add a rotary motion. Some of the uses of this instrument are: to seat and unseat ball joints for the introduction or removal of material; as a ring stand to position evaporating dishes over burners or hotplates; to elevate liquid reagent containers for control of gravity flow. By reversing the functions, i.e., clamping the mechanism and allowing the rod to move, its usefulness may be extended: to introduce samples into furnaces with small apertures; to lower material into Dewar flasks.

1245 A focalization device for electrically-neutral particles. Reńe Vauthier. *Compt. rend. 228*, 1113-4(1949) Mar. 28 (in French).

An analogy is established between the behavior of a charged particle inside a condenser, and that of a neutral particle in the inhomogeneous magnetic field of the Stern-Gerlach experiment. In the first case the force is eE, in the second, $M_B \cdot \partial H/\partial x$, ($M_B$ is the Bohr magneton); the trajectories are similar. Herzog, *Zeitsch. Physik 89*, 447(1934), showed that in a cylindrical condenser a focusing of a divergent monoenergetic ion stream can be obtained; a heterogeneous stream, entering the condenser through a slit, produces an energy spectrum of the particles. The present author suggests an analogous magnetic device, in which the pole pieces of Stern and Gerlach are curved. The principal trajectory will satisfy the relation $mv^2/r = (M_B/N)\cdot\partial H/\partial x$, where $m = M/N$, M is the molecular mass, N is the Avogadro number, $v = (3.5\ RT/M)^{1/2}$ is the most probable velocity of particles escaping from a container through a hole in the wall. We have $r = 52{,}000\ T/(\partial H/\partial x)$, which does not depend on M, because the device discriminates energies only. For T = 300°K and $\partial H/\partial x = 3 \times 10^5$ gauss/cm, r = 50 cm. The following are the principal difficulties in the way of the realization of the device: the field gradient must be made constant; the present obtainable limit $\partial H/\partial x$ being 4×10^6 gauss/cm, the gas or vapor temperature could not exceed 800°K if the instrument is not to be too bulky; only atoms or molecules bearing one Bohr magneton could be used. A possible shape of the electromagnet is shown in a figure.

1246 Operation of the electronic analog computer, model GN184-LI. Goodyear Aircraft Corporation Report No. GER-1927, Oct. 11, 1948. 58p. (NP-797).

The Model GN184-LI computer employs d-c amplifiers as the basic calculating unit. With the application of certain combinations of input and feedback impedances, these amplifiers perform certain linear functions. A general treatment of the operation and performance of the principal components and the capabilities, limitations, and manipulation of the equipment is given. Practical application of the computer for multiplication, summation, integration, differentiation, and complex operations are discussed. A sample problem on the response of an automatically controlled aircraft to a control signal, using two computers, is set up and solved.

1247 Several improvements on the "Philip's gauge." C. Hayashi, K. Hashimoto, K. Kaneko, K. Okamoto, and R. Sagane. *Rev. Sci. Instruments 20*, 524-6(1949) July (Laboratory and shop notes).

By varying the geometrical configuration and dimensions of the Philip's gauge, or cold cathode ion gauge, Robert G. Picard, *Rev. Sci. Instruments 17*, 125(1946), the range has been extended to read pressures of $10^{-6} - 10^{-1}$ mm of Hg. Pressure-current curves are shown and it is noted that the large type (10 cm in diameter) which was used at the low-pressure end of this range is suitable for use at the high voltage end of a Van de Graaff generator, and in similar applications.

1248 Note on the mass number of 10h Y. B. Selikson and J. M. Siegel. AECD-2668, nd. Decl. Aug. 8, 1949. 6p. For publication in NNES.

Repeated separations of Zr were made from an intense source of 10h Y in a rare earth fraction of fission products, to see if the 10h Y is the precursor of 65d Zr^{95}. Negligible activity of Zr^{95} was found, indicating that the 10h Y does not have mass number 95. Other evidence suggests the mass number 93. The observations also show that the maximum value for the half-life of Y^{95} is 1.5 hr.

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1249 Mass assignment of the 43-minute Hg isomer. Ingmar Bergström and Sigvard Thulin. *Phys. Rev.* 76, 313(1949) July 15 (Letter to the editor).

An electromagnetic isotope separator has been used to determine the mass number of the 43-min activity of Hg. The results obtained indicated that this activity, which has been previously observed and associated with an isomeric state, can be ascribed to mass number 199. Subsequent to irradiation of a Hg sample with Be-neutrons from a 6.5-Mev cyclotron, the container was introduced into the ion source of the separator by means of a vacuum lock device. From further experiments evidence was obtained that both the reaction $Hg^{199}(n,n)Hg^{199*}$ and $Hg^{200}(n,2n)Hg^{199*}$ occur. The results are in agreement with the observations of Sherr, et al, *Phys. Rev.* 60, 473(1941), and Wu, et al, *Phys. Rev.* 63, 227(1943).

1250 "Heat flush" method of He^3 separation. Charles A. Reynolds, Henry A. Fairbank, C. T. Lane, B. B McInteer, and Alfred O. Nier. *Phys. Rev.* 76, 64-6(1949) July 1.

Further determinations have been made of the efficiency of separation of He^3 from mixtures of He^3 and He^4, by a method making use of the "internal convection" process in superfluid liquid He. It is shown that the method is capable of removing all the He^3 in mixtures with an original He^3/He^4 abundance of 10^{-2}% in a period of about 5 min with a power input of 13 mw. The efficiency of the method as a function of power input is also studied and comparison is made with Kapitza's measurements on the "latent heat" of superfluid atoms, *J. Phys. U.S.S.R.* 5, 59(1941).

1251 Design for a metal mass spectrometer tube. W. M. Hickam. *Rev. Sci. Instruments* 20, 472-6(1949) July.

A 90° sector type mass spectrometer tube made of Monel is described. The design is such that the electrode assemblies and analyzer section are easily removable without destroying the slit alignment. A double gasket arrangement is used for making the necessary high vacuum seals. The tube can be operated at an elevated temperature with no cold spots which is particularly desirable for degassing and for studying samples which have low vapor pressures. Operation of the analyzer section at any desired potential with respect to ground is permitted.

1252 Absolute fission yields in uranium and plutonium. D. W. Engelkemeir, B. Finkle, M. S. Freedman, A. Goldstein, E. J. Hoagland, S. Katcoff, T. B. Novey, D. Schover, R. Schuman, C. Schwob, J. A. Seiler, E. P. Steinberg, N. Sugarman, and L. Winsberg. AECD-2655, nd. Decl. May 13, 1949. 1p.

This document is in abstract form; it is reproduced below in its entirety.

A summary review will be presented of the extensive experimental determinations of the absolute yields of the products of U and Pu fission. The fission process directly yields two massive particles, the precursors of the β-decay chains, whose mass and charge numbers are independently distributed over a wide range. The probability of direct formation is defined as the independent fission yield. The total fission yields of the longer lived later members of the chains, which are of primary interest, receive small (usually negligible) contributions from independent formation in fission.

In the direct determination of fission yields, the fissions occurring in a thin sample of fissile material are counted in a fission chamber immersed in a flux of slow or fast neutrons. An adjacent massive sample irradiated simultaneously is radiochemically analyzed for the fission product of interest. The ratio of weights of heavy and thin sample determine the fissions in the former. The number of atoms of the fission product formed is found by counting its β-particles. Discussion will cover radiation, chemical and counting considerations, and the factors involved in calculating the disintegration rate from the observed counting rate.

In the indirect or relative method, radiochemical analyses determine the ratio of the beta disintegration rates of two isotopes at saturation, the yield of one having been determined by the direct method; from this ratio the unknown yield is obtained. The fission yield-mass number distributions for slow neutron fission of U and Pu will be compared.

1253 Neutron physics – a revision of I. Halpern's notes on E. Fermi's lectures. J. G. Beckerly. AECD-2664, 1949. Decl. Aug. 12, 1949. 97p. (See also MDDC-320).

The notes issued as MDDC-320 have been revised. The principal revisions in the text consits of expanding some of the statements for clarity and adding sentences and footnotes for completeness. Problems have been numbered and grouped at the end of each chapter. Figures have been redrawn, and in a few cases new ones added. Occasionally additional material has been introduced for clarity

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and to include more recent data. Chapters on neutron sources, collisions of neutrons with nuclei, a stable isotope chart and reactions involving neutrons, models of nuclei and nuclear reactions, the scattering of neutrons, the slowing down of neutrons, the distribution of slow neutrons in a medium, and nuclear fission are presented.

1254 N-P scattering experiments at 280 Mev. E. Kelly, C. Leith, and C. Wiegand. AECU-388, nd. 1p.

This document is in abstract form; it is reproduced below in its entirety.

The total n-p cross section and the angular distribution of the scattered protons have been studied with the same method used at 90 Mev, *Phys. Rev. 75*, 351(1949). The total cross section is approximately 0.03 barns. The angular distribution will be shown. It varies from about 0.013 barns at 180° to 0.002 barns at 90° in the center of mass system.

1255 Angular distribution of neutrons from (d,n) reactions. C. E. Falk, E. Creutz, and F. Seitz. *Phys. Rev. 76*, 322-3(1949) July 15 (Letter to the editor) (See also NSA 1-1863).

Further results, *Phys. Rev. 74*, 1226(1948), of preliminary experiments on the angular distributions of neutrons from (d,n) reactions are given. Deuterons of approximately 16-Mev energy were used to bombard thick targets of the following: $LiBO_2$, Be, Cu, and Au. Angular distribution curves for the neutrons from the reactions with Au and $LiBO_2$ are given and the Q-values for all the reactions are tabulated. It is noted that the neutron angular distribution is sharply peaked in the foreward direction in all cases. Half-lives of the product nuclei and threshold energies are also given in tabular form. It is noted that the data for the gold is hard to reconcile with Serber's stripping theory, *Phys. Rev. 72*, 1008(1947), and that the distinct directionality of the distribution is difficult to explain by a simple isotropic evaporation theory of a liquid drop compound nucleus.

1256 Angular distribution of photo-neutrons from deuterium. Edwin P. Meiners, Jr. *Phys. Rev. 76*, 259-63(1949) July 15.

A study has been made of the angular distribution of photo-neutrons from deuterium using 2.76-Mev Na^{24} γ-rays under approximately ideal conditions of low neutron scattering from the general surroundings into the detector. Results were obtained for two general methods of neutron detection, i.e., a boron trifluoride chamber and the Szilard-Chalmers reaction on calcium permanganate. Assuming the neutron distribution to have, in the barycentric system, the form $I(\theta) = a + b \sin^2\theta$, the values of a/b obtained are 0.212 ± 0.008 for the first method and 0.203 ± 0.040 for the second, giving as a weighted average 0.211 ± 0.008. From this, the ratio of the photomagnetic cross section to the photoelectric cross section is calculated to be 0.317 ± 0.012.

1257 Bremsstrahlung in high energy nucleon-nucleon collisions. J. Ashkin and R. E. Marshak. *Phys. Rev. 76*, 58-60(1949) July 1.

Formulas for the differential cross sections for the continuous γ-emission accompanying proton-neutron, proton-proton and neutron-neutron collisions have been derived. Numerical results are given for an incident nucleonic energy of 250 Mev.

1258 Electrostatic scattering of neutrons. S. M. Dancoff and S. D. Drell. *Phys. Rev. 76*, 205-212(1949) July 15.

Calculations have been made which indicate that the interaction between electrons and thermal neutrons can be suitably described by the meson theory. A weak force of attraction between electrons and thermal neutrons is indicated in recent experiments by Havens, et al, *Phys. Rev. 72*, 634(1947), and by Fermi, et al, *Phys. Rev. 72*, 1139(1947). According to meson theory this would be expected, since the neutron is considered as one charge state of a nucleon (the proton is the other state) which is coupled to a meson field. The attraction is then interpreted as an electrostatic scattering of the neutron which exists part of the time as a proton and meson. A third order perturbation calculation in the approximation of weak coupling between mesons and nucleons is performed. Neutrons and protons are treated as Dirac particles which are coupled to a meson field of spin zero.

1259 Intercalibration of neutron sources. D. L. Allen and M. J. Poole. Atomic Energy Research Establishment Report No. AERE-N/R-225, nd. 17p.

This paper describes the method adopted to obtain intercalibration between natural neutron sources of different neutron energies, in order that they may be used to determine the energy response curve for neutron detecting devices. As a consequence of these measurements it was possible to

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evaluate the ratio between the cross sections for (γ,n) reactions in Be and D. The method adopted was to suspend each source in turn in a large tank of water and integrate by means of slow neutron detectors (Mn or In) the slow neutron density set up throughout the tank. A semi-automatic method making use of moving foils is employed to carry out the integration. Because of lack of information about the ratio between the H and Mn capture cross sections, the absolute efficiency of counting of the activity, and the disturbance caused to the neutron density distribution by the presence of absorbing detectors, this method only leads to a relative, and not an absolute, calibration of sources. An accuracy of ±2% is claimed for the results.

1260 Ionization measurement of He^3 (np) and N^{14} (np) and the neutron-hydrogen mass difference. W. Franzen, J. Halpern, and W. E. Stephens. *Phys. Rev. 76*, 317-8(1949) July 15 (Letter to the editor).

The pulse-size distribution arising from electron collection of the ionization produced by the reactions $He^3(n,p)H^3$ and $N^{14}(n,p)C^{14}$ induced by slow neutrons was observed using a cylindrical ionization chamber filled with an A-N-He (enriched in He^3) mixture. Pulse-height distribution curves are shown. If a linear relation between energy and ionization is assumed in A, in accordance with the results of Jesse, *Phys. Rev. 74*, 1259A(1948) and *75*, 1110(1949), then the energy equivalents of the total ionization produced in He^3 (n,p) and N^{14}(n,p) are 764 ± 10 kev and 628 ± 4 kev, respectively, when a direct comparison is made with Po α-particles (assumed to have an energy of 5298.4 kev). The results obtained support the assumption of a constant average energy per ion pair in A. The energies obtained agree well with the thresholds for the inverse (p,n) reactions, 620 ± 9 kev[8] and 764 ± 1 kev[9], respectively, and an ionization determination of N^{14}(n,p), using total ion collection of 630 ± 10 kev[10]. Assuming zero neutrino mass, the results lead to a neutron-H mass-difference of 783 ± 4 kev.

1261 Neutron cross sections at 115 ev and 300 ev—I. C. T. Hibdon and C. O. Muelhause. *Phys. Rev. 76*, 100-6(1949) July 1.

Total neutron cross sections for a number of elements were measured at 115 ev and 300 ev with an energy resolution of approximately 10%. The cross sections were separated into two parts: a resonance cross section and an asymptotic cross section. The first cross section represented the effect of a neutron resonance in the material studied overlapping the detector. The second cross section was identified either as the potential scattering cross section, or a minimum cross section in the neighborhood of a resonance.

1262 The neutrons emitted in the disintegration of lithium by deuterons. L. L.Green and W. M. Gibson. *Proc. Phys. Soc. (London) 62*, 407-15(1949) July 1.

The photographic plate method has been used in investigation of the neutrons from the reaction $Li^7 + D^2 \rightarrow Be^8 + n^1$. The results are in general agreement with those of Richards, *Phys. Rev. 59*, 796(1941), but show the structure of the neutron groups more clearly. In particular, the shape of the broad group attributed by Richards to a level in Be^8 at 3.0 ± 0.4 Mev is discussed in detail. The total energy release is 15.0 ± 0.15 Mev, and evidence for the existence of energy levels in Be^8 at 2.8 Mev, 4.05 Mev, 4.9 Mev, and 7.5 Mev is discussed and described. 16 references. 9 figures.

1263 On nucleon moments and the neutron-electron interaction. K. M. Case. *Phys. Rev. 76*, 1-13(1949) July 1.

Using the newly developed computational techniques and the covariant formalism, the nucleon magnetic moments and the neutron-electron interaction are calculated. A pseudoscalar meson theory is assumed. Finite and unambiguous results are obtained to the lowest non-vanishing order in the coupling constants. These depend on the unknown strength of the meson coupling. Although a reasonable value may be used to fit the proton moment, the corresponding neutron moment comes out much too large. With this fitting, the neutron-electron potential is found to be an attractive potential with an equivalent well depth of the order of five to ten kilovolts.

1264 On the interpretation of neutron-proton scattering data by the Schwinger variational method. John M. Blatt and J. David Jackson. *Phys. Rev. 76*, 18-37(1949) July 1.

Variational methods developed by Schwinger, *Phys. Rev. 72*, 742A(1947), are applied to neutron-proton scattering at energies below 10 Mev. S-wave scattering alone is considered, and the tensor force is not taken into account. An expansion is obtained for the phase shift in powers of the energy. The coefficients can be evaluated explicitly from the wave function. The first term of the series is related to Fermi's scattering length and the second term involves an "effective range." The third

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and higher terms are found to be negligible. The results are used to define an "intrinsic range" for a potential well of arbitrary shape. Thus a reasonable comparison of potential wells of different shapes is made possible. The relation between intrinsic range and effective range is discussed. The experimental data on coherent and incoherent neutron-proton scattering are discussed in terms of a "shape-independent" approximation. The best value for the effective range in the triplet state is $r_t = (1.56 \pm 0.13) \times 10^{-13}$ cm. The effective range in the singlet state is not well determined by the present data. Also considered is the effect of higher, shape-dependent terms in the expansion of the phase shift. These terms become more important as the well shape becomes more "long-tailed," but they are found to be negligible within experimental uncertainties for the four well-shapes considered here (square, Gaussian, exponential, and Yukawa). The results for the scattering phase shifts can be extrapolated to negative energy to give an approximate algebraic equation for the energy of the bound state of the deuteron. All the numerical results are shown in graphical form; interpolation formulas are provided where higher accuracy may be needed. 35 references.

1265 The range of certain fission products of uranium in various materials. Francis Suzor. *Ann. Phys.* *4*, 269-309(1949) May-June (in French).

Measurements were made of the range in Al, and of the range fluctuations, of Zr^{17}, $Te^{(132)}$, and Mo^{99}, obtained in the uranium fission reaction. The fluctuation in Al was found to exceed that given by Bohr's theory, *Phys. Rev.* *58*, 654(1940), and *59*, 270(1941). With Au this discrepancy is still larger. A comparison was made of ranges of the fission products obtained first by using predominantly thermal neutrons, then fast neutrons; the results seem to indicate that the total kinetic energy liberated in the case of rapid neutrons is smaller, by about 4 Mev, than that corresponding to thermal neutrons. For the three fission products investigated, stopping power of Au, Ag, Cu, and cellulose acetate, relative to that of Al were determined. For the case of thermal neutrons, a study was made of the formation probabilities of the three fission products, and of the maximum energy of β-spectra of the products and of their β^--radioactive descendants.

1266 Theory of the effective range in nuclear scattering. H. A. Bethe. *Phys. Rev.* *76*, 38-50 (1949) July 1.

The scattering of neutrons up to about 10 or 20 Mev by protons can be described by two parameters, i.e., the scattering length at zero energy and the effective range. A formula expressing the phase shift in terms of these parameters is derived; it is identical with one previously derived by Schwinger but the derivation is very much simpler. Reasons are given why the deviations from the simple formula are very small, as shown by the explicit calculations by Blatt and Jackson, *Phys. Rev.* *76*, 18-37(1949). The theory is then applied to proton-proton scattering, with a similarly simple result. Moreover, a method is developed to compare proton-proton and proton-neutron scattering without explicit calculation of a nuclear potential. The most recent experimental results are evaluated on the basis of the theory, and accurate values for the effective ranges are obtained for the triplet scattering of neutrons, and for proton-proton scattering. The nuclear force between two protons is clearly found to differ slightly from that between neutron and proton in the singlet state. All actual results agree with those obtained by Breit and collaborators, *Phys. Rev.* *55*, 1018(1939); *56*, 884(1939), and by Blatt and Jackson.

1267 Nuclear magnetic moments and hyperfine structure of the rubidium isotopes. F. Bitter. *Phys. Rev.* *76*, 150(1949) July 1 (Letter to the editor).

The discrepancy between the ratio calculated from the hyperfine structure and the results recently obtained, *Phys. Rev.* *75*, 1326(1949), for the ratio of the magnetic moments of the Rb isotopes, $\mu Rb^{87}/\mu Rb^{85}$, is discussed in order to determine whether the fact that the observed value is higher than the calculated value can be accounted for on the basis of either electrostatic or magnetic forces. It is concluded that the latter type of forces are more probably the cause of the observed lack of agreement between theory and experiment.

1268 The nuclear spin and quadrupole moment of I^{129}. Ralph Livingston, O. R. Gilliam, and Walter Gordy. *Phys. Rev.* *76*, 149-50(1949) July 1 (Letter to the editor).

The nuclear spin and quadrupole moment of I^{129} have been determined from measurements on the $J = 2 \rightarrow 3$ rotational transition of CH_3I^{129}, which occurs in the 6.75 mm wave region. The results obtained for the hyperfine structure are shown and compared with the calculated values; the spin of I^{129} is clearly 7/2. The alternative methods by which the quadrupole moment may be estimated are considered. The method preferred by the author is based on microwave measurements and gives a value for the quadrupole moment of -0.43×10^{-24} cm^2. An attempt to determine the nuclear magnetic moment of I^{129} from the Zeeman effect on the hyperfine structure is now in progress.

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1269 On the classification of heavy nuclei. André Broniewski. *Compt. rend. 228*, 174-6 (1949) Jan. 10 (in French) (See also NSA 3-1142).

Several authors have emphasized the stability of the Pb^{208} nucleus (82 protons and 126 neutrons). Two straight lines $\Delta N = 2\Delta Z$ (1), and $\Delta N = \Delta Z$ (2), starting at the point Z = 82, N = 126, have the following properties. For $Z \geq 88$, the line (1) passes through points (of even Z) corresponding to Ra, Th, and UI, all three α-emitters and all elements of least disintegration energy among the respective isotopes; for $Z < 88$, the line (1) passes below the points representing similar α-emitters of least energy, Rn and RaA. The line (2) passes through points corresponding to Pu^{232}, U^{228}, Th^{224}, Ra^{220}, Rn^{216}, and ThC′, all α-emitters of which it is known that their disintegration energies exceed 6.6 Mev. All other known α-emitters occupy intermediate positions. If the Pb^{208} nucleus is to be considered as a condensed central part of the other nuclei, the most stable, and the least stable, configurations of the external nucleons are, in general, those represented by the equations (1) and (2). If the equation (1) is valid for $Z > 92$, one may expect the discovery of trans-uranians of even Z, low energy α-emitters; these would be Pu^{244} and Cm^{250}.

1270 On the sign of the electric quadrupole moment of Li^7. P. Kusch. *Phys. Rev. 76*, 138-9 (1949) July 1 (Letter to the editor).

Experiments are discussed which indicate that the nuclear electric quadrupole moment of Li^7 is positive, contrary to the negative moment which is predicted on the basis of all the proposed nuclear models. The sign of the coupling energy of the quadrupole moment of a nucleus with the gradient of the electric field, produced at that nucleus by the electrons and the other nucleus in certain diatomic molecules, was determined. A theoretical calculation of the electric field gradient was then made in order to derive the sign of the quadrupole moment. The method used is discussed; a wire was interposed at an appropriate point along the path of the molecular beam in order to identify the necessary maxima in terms of the quantum numbers of the terminal states.

1271 Relation of nuclear quadrupole moment to nuclear shell structure. Walter Gordy. *Phys. Rev. 76*, 139-40(1949) July 1 (Letter to the editor).

The dependence of the nuclear shape upon the nuclear shell structure, as evidenced by the nuclear quadrupole moment, is noted. Plots of the nuclear quadrupole moment as a function of the number of protons in the nucleus and as a function of the number of neutrons in the nucleus and data correlating the quadrupole and nuclear magnetic moments of isotopic pairs having the same spins are shown and discussed. The relationship found provides new evidence for the existence of shell structure in nuclei. Evidence is also given for an inter-relation of the nuclear magnetic moment to the nuclear quadrupole moment, when the nuclei are similar.

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1272 An absolute calibration of the $Li^7(p,n)$ threshold voltage. W. E. Shoupp, B. Jennings, and W. Jones. Westinghouse Research Laboratories. Dec. 29, 1948. 18p. (NP-815).

The $Li^7(p,n)$ threshold has previously been the most generally accepted secondary voltage standard for nuclear experiments done with an electrostatic generator. Recent measurements of this threshold by electrostatic analyzer methods have given a result about 2% higher than the older value made by an extrapolation of a resistor measurement of the $Li(p,\gamma)$ resonance at 440 kv. The $Li^7(p,n)$ threshold measurement by a third method, the radio frequency ion speed gauge is reported here. The calibration by this method is absolute in that the kinetic energy of the particle is determined in terms of its known mass to charge ratio and two easily measurable parameters; a length and a frequency. The results of this calibration place the threshold at (1.8812±0.1%) Mev which is in good agreement with values obtained from the electrostatic analyzer measurements.

1273 Angular distribution of protons in the N^{14} (dp)N^{15} reaction. L. D. Wyly. *Phys. Rev.* 76, 104-6(1949) July 1.

The Yale cyclotron was used to investigate the angular distributions of protons emitted in the reaction $N^{14}(d,p)N^{15}$ employing bombarding energies between 1.5 Mev and 3.0 Mev. Both the ground state and first excited state protons were studied. Over the energy range used, the protons emitted in the formation of the ground state are found to have a slightly higher yield in the forward direction while those emitted in the formation of the first excited state are essentially spherically symmetric. Neither distribution shows marked variation with energy.

1274 The angular distribution of the photo-disintegration of the deuteron. W. M. Woodward and I. Halpern. *Phys. Rev.* 76, 107-13(1949) July 1.

The distribution of protons from the photo-disintegration of the deuteron was measured in detail as a function of the angle at an energy of 0.48 Mev above the threshold. The observed angular distribution agreed with the prediction of the theory. Measurements of the variation of the angular distribution with energy agreed qualitatively with the theory but seemed to give too high a value for the ratio of photo-magnetic to photo-electric disintegration cross sections.

1275 Evidence for the photo-fission of uranium into three charged fragments. E. W. Titterton and F. K. Goward. *Phys. Rev.* 76, 142(1949) July 1 (Letter to the editor).

Ilford type D_1 plates 100-μ thick have been impregnated with a saturated solution of uranium acetate and irradiated with 23-Mev γ-rays from the Harwell synchrotron. Exposures of up to 300 r have been employed and photo-fissions are observed at approximately the rate to be expected from the cross section given by Baldwin and Klaiber, *Phys. Rev.* 71, 3(1947). In the course of examining the plates four cases of photo-fission into three charged fragments, were observed and a photomicrograph of one of them is shown. Tabulated data are given on the range, energy, and angle of emission of the particles observed in these four events, which are believed to be the first of their type reported in photo-fission. The rate of occurrence of this mode of fission is tentatively given as 1 per 400±200 binary photo-fissions.

1276 Gamma-radiation from light nuclei under proton bombardment. W. A. Fowler and C. C. Lauritsen. *Phys. Rev.* 76, 314-5(1949) July 15 (Letter to the editor).

Additional studies of the γ-radiation emitted in the bombardment of light nuclei by protons which have been made by several observers during the past year make it advisable to revise data previously summarized on this subject, *Rev. Mod. Phys.* 20, 248(1948). Revised yield and energy measurements are given for the following reactions: $F^{19}(p\alpha',\gamma)$, $Li^7(p\gamma)$, $C^{12}(p\gamma)$, $C^{13}(p\gamma)$, $F^{19}(p\alpha',\gamma)$ $Be^9(p\gamma)$, $Li^7(pp',\gamma)$, and $F^{19}(p\alpha',\gamma)$.

1277 Theory of the photo- and electrodisintegration of Be^9. Eugene Guth and Charles J. Mullin. *Phys. Rev.* 76, 234-44(1949) July 15 (See also NSA 1-1485 and 1-1486).

Cross sections for the photo- and electrodisintegration processes at relatively low energies have been calculated as a function of energy on the basis of a simple model of the Be^9 nucleus in which a neutron is assumed to move in the potential well provided by the remainder of the nucleus. According to the theory, the disintegration at low energies results primarily from electric dipole transitions from the ground $P_{3/2}$ state to S and D states in the positive energy continuum. Magnetic dipole disintegration does not seem to play an important role. In order to

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obtain agreement between the theoretical and empirical photo-disintegration cross sections, it seems necessary to make the plausible assumption that the interaction between the prospective photo-neutron and the remaining nucleons of the nucleus is a function of the orbital angular momentum of the system (Majorana interaction). Furthermore, complete neglect of the $P_{3/2}$–$P_{1/2}$ splitting of the lowest P state leads to an angular distribution of the ejected neutrons which does not agree with the (preliminary) empirical results. Using the Born-Møller approximation, the cross section for electrodisintegration has been calculated in terms of the photodisintegration cross section. This method yields a correlation, which is independent of the nuclear model, between the observed photo- and electrodisintegration cross sections. The theory based upon the simple model described seems adequate for an interpretation of the experimental data. 39 references. 8 figures.

1278 Operation of 1/4 scale model Bevatron. E. J. Lofgren. AECU-372, June 13, 1949. 10p.

Accelerated protons were first observed in the 1/4 scale model proton-synchrotron on April 30, 1949. Subsequent operations are described in relation to the beam injection, beam detection and magnitude, vacuum in the tank, size and regulation of the tank aperture, beam distribution on the first turn, inflector obstruction of the accelerated beam, and efficiency of the accelerator.

1279 A high intensity cyclotron. E. J. Lofgren. AECU-389, nd. 1p.

This document is in abstract form; it is reproduced below in its entirety.

Preliminary experiments have been carried out on the use of a cyclotron as an injector for the Bevatron. We have obtained 20 ma of 1 Mev protons circulating in pulses with a duty cycle of 1:1000. It has been possible to deflect 7 ma and by the use of a wedge shaped magnetic field to bring 2/3 ma to a focal spot about 1/2 in. x 1 1/2 in. 8 ft from the cyclotron. The source is a cold cathode arc inside of a 1/2 in. diameter tube whose axis is parallel to the field. The ions are withdrawn from a vertical slot in the tube by a pair of slits mounted on one dee. A large change of radius during the first turn is necessary so that the ions shall not strike the source. This condition is met by a magnetic field of 7000 gauss and 70 to 100 kv r-f between dees. A deflector with a longitudinal channel has been successfully used. It makes the deflector insensitive to positional or voltage adjustment since ions deflected too far feel a reduced electric field and move in again. Many suggestions were made by E. O. Lawrence, including the channel deflector.

1280 4 Mev Van de Graaff and 40 foot linear accelerator specifications. W. P. Sessions. AECU-391, June 24, 1949. 11p.

1281 Construction report; 130-in. Rochester cyclotron; July 1946-July 1949. S. W. Barnes, R. L. McCreary, A. Clark, Wm. Mortenson, H. Logemann, and C. Oxley. University of Rochester (Office of Naval Research Contract). July, 1949. 95p. (NP-979) (See also NSA 2-1993).

This report covers the work of the three years since July, 1946, on the construction of the Rochester cyclotron and presents a brief summary of the research undertaken during the last six months with 240-Mev protons. The following topics are discussed in detail: magnet, dee tank, vacuum system, dee and liner, rotating condenser, tank grids, power system, control system, cooling system, operating techniques, proton-proton scattering experiments, and shielding problems.

1282 Elastic constants and sound velocities. II. Longitudinal, torsional, and bending vibrations of loaded bars. Myra F. Kilpatrick. AECU-375, Mar. 8, 1949. 17p.

One of the methods for measuring elastic constants of materials involves attaching a piezoelectric crystal to each end of a bar of the material and observing resonance frequencies. Means for correcting for shifts in the various resonance frequencies produced when a crystal is attached at each end of a bar are discussed. Expressions which predict the observed frequency shifts produced, in order to arrive at the so-called zero frequencies which the metal bar would exhibit if it were not loaded, are set up. Differential equations for the longitudinal, torsional, and bending motions of the bar are derived and expressions for the frequencies of the various modes are arrived at. The solutions so obtained are not completely rigorous since certain assumptions are

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made in the setting up of the differential equations. Also there are physical limitations to the mathematical expressions for continuity conditions at the boundaries of the bar.

1283 The effect of alpha particles on a superconductor. D. H. Andrews, R. D. Fowler, and M. C. Williams. *Phys. Rev. 76*, 154-5(1949) July 1 (Letter to the editor).

Superconducting bolometers have been bombarded with α-particles from a Po source, and it was found that countable electrical pulses are produced, one for each particle impact. The bolometer used in the experiment reported was made of a strip of CbN, approximately 3.4 x 0.4 x 0.006 mm, mounted with bakelite lacquer on a Cu base, and maintained at the operating temperature of 15.5°K in a cryostat, as previously described, Andrews, et al, *J. Optical Soc. Am. 36*, 518(1946); its time constant was about 10^{-3} sec. The number of counts/sec was a function of the direct current flowing through the CbN, being at a maximum for a current of 40 ma, as well as of the temperature. Since the pulse height may be expected to be proportional to the energy of the α-particle, experiments are being continued to increase the signal to noise ratio, in order to evaluate the precision with which the energy of individual particles can be measured by this method, and to determine the kind of pulses produced when superconducting bolometers of this and other materials are exposed to different kinds of particle radiation.

1284 An electronic method for approximating the frequency spectra of transient functions. E. S. Hoffer. Naval Research Laboratory Report NRL-F-3406. Jan. 27, 1949. 13p.

It is shown that any method for obtaining the spectra (i.e., plots of component amplitude versus frequency) of periodic functions can be used, in a manner described, to determine approximately the spectra of a broad class of transient functions. The problem is thus simplified in that only an instrument for obtaining the spectra of periodic functions need be found. A wave analyzer is then considered as such an instrument.

1285 Note on the importance of imperfect-gas effects and variation of heat capacities on the isentropic flow of gases. Coleman D. Donaldson. National Advisory Committee for Aeronautics Report No. NACA-RM-L8J14, Dec. 10, 1948. 21p.

The errors involved in using the perfect-gas law, $pv = RT$, and the assumption of constant heat capacities are evaluated. The basic equations of gas glows taking into account these phenomena separately and at the same time are presented.

1286 Tables of dielectric materials. Volume III. MIT Laboratory for Insulation Research Technical Report No. X (Office of Naval Research Contract). June, 1948. 62p. (NP-906).

Dielectric characteristics of about 400 materials have been compiled.

1287 A modified decade scaler. Final report on project authorization number CMR-3-5. George N. Rupert. AECU-376, June 9, 1949. 13p.

An automatic decade scaler which operates for a fixed number of counts has been developed for use with a Geiger tube. The elapsed counting time is read by a 115v a-c clock to 0.01 min. Manual operation is provided to allow the scaler to be run for a fixed time interval in which case every 10,000 counts are recorded by a cyclotron recording meter. The instrument has a two pulse resolution time of 25 μ-sec. Four decades in cascade are used in the scaler, one of which has a resolution time of 8 μ-sec; the other three, a resolution time of 30 μ-sec. Ten Ne bulbs are used in each decade to indicate the count.

1288 A circuit for the study of the operation of the Geiger-Müller counter. Mario Alves Guimarães and Palmyra Amazonas Sampaio. *Rev. Sci. Instruments 20*, 485-8(1949) July.

The vacuum tube circuit described, was designed in order to measure the effective dead-time (σ') of a Geiger-Müller counter and, the probability (α') of the occurrence of spurious discharges within a given interval of time ($\zeta-\sigma'$) after an initial discharge. The experimental results obtained permit the determination of (α') and, in some cases, (σ'), by means of an appropriate formula.

1289 A direct reading pulse length meter and shape analyzer. Robert Rudin. *Rev. Sci. Instruments 20*, 467-71(1949) July.

An electronic circuit is described which allows determination of the length and shape of a voltage or current pulse in the microsecond range, by measuring the pulse duration at different

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levels of the pulse and reading these figures directly on a meter. Comparison with other measuring methods shows good agreement of the results.

1290 An instrument for measuring curvature of cloud-chamber tracks. E. R. Gaerttner and M. L. Yeater. *Rev. Sci, Instruments 20*, 526-7(1949) July (Laboratory and shop notes).

An instrument which is a modification of the three-point method of measuring the curvature of cloud-chamber tracks is described. This device enables the independent adjustment of the three points to the curve and after each point is adjusted it is locked. The essential features of the instrument are indicated in a drawing. The results obtained indicate that tracks of small curvature can be measured with greater rapidity and precision with this device. Measurements of electron tracks by two observers indicate an accuracy of about 5% for tracks of 50-Mev electrons curved in a field of 4,000 gauss. It is noted that the rotational degree of freedom makes the instrument useful for angle measurement, e.g., the horizontal projection of the angle which a curved track makes with a lamina in the cloud chamber.

1291 A large cloud chamber using rear illumination. E. W. Cowan. *Rev. Sci. Instruments 20*, 492-5(1949) July.

A large cloud chamber is described that makes use of rear illumination by means of a transparent piston and back plate. This system of illumination is particularly advantageous for a large cloud chamber since the increase in the amount of scattered light for small angles of scattering from droplets reduces the total light required.

1292 Measurement of energy of charged particles (excluding electrons and mesons). W. B. Lewis. National Research Council of Canada Report No. DL-3, July 28, 1949. 15p.

This report consists of a lecture, with references to illustrative slides. A brief history and comparison of general methods are given. The following specific methods of measurement are reviewed: magnetic deflection, electrostatic acceleration or deceleration, electrostatic deflection, velocity measurement by timing, energy measurement by timing, energy measurement by heat and count of particles, total ionization of gases, specific ionization of gases, range measurements, scintillations, and scattering statistics.

1293 Nuclear research emulsion techniques. K. R. Eldredge. Office of the Naval Attache London. Jan. 5, 1949. 6p. (NP-911) (See also NSA 2-555).

This report summarizes the information obtained at a conference between the author and members of the staff of Kodak, Ltd., as well as information obtained by the author by observing experimental work. The techniques for handling stripped film and thick emulsion development and processing are discussed in some detail. Several phases of research in progress connected with photographic emulsion detectors being carried on by this company are briefly commented upon.

1294 A pantograph and tilting stage for use with nuclear plates. Ian Barbour. *Rev. Sci. Instruments 20*, 530-1(1949) July (Laboratory and shop notes).

Two attachments are described which are useful in the microscropic examination of nuclear emulsion plates. A pantograph is described, suitable for attachment to the moving stage of the microscope, which provides a permanent plot of the location of events on the plate. The precision in locating points in one region of the plate is about 20μ, and about 75μ in comparing points of wide separation. This device is particularly useful in tracing meson tracks from one plate to another, particularly in connection with magnetic deflection experiments. A tilting stage for viewing tracks which dip into the emulsion is also described. This permits the observer to maintain a good focus throughout the field of view after tilting. Tracks which pass through the plate at angles of up to 26° with the emulsion surface can be brought into the focal plane of the lens.

1295 Removal of space-charge in diamond crystal counters. A. G. Chynoweth. *Phys. Rev.* 76, 310(1949) July 15 (Letter to the editor).

A method of neutralizing the space-charge, which develops in a crystal counter and is produced by electrons and possibly by positive holes, is described. Irradiation of the specimen with a spectrum extending from about 1 mμ to 10 mμ should be sufficient to de-trap most of the electrons; a Nernst filament produces a spectrum of this type. Experiments were performed, in

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which Nernst light was focused on the crystal simultaneously with bombardment by α particles from polonium, and no photo-conductivity was detected. A curve is given showing the variation of counting rate with time during the irradiation of the diamond with Nernst light. This method appears to be as satisfactory as the field reversal method, *Phys. Rev. 72*, 1127(1947) for the removal of space charge.

1296 Scintillations produced by α-particles in a series of structurally related organic crystals. W. S. Koski and Carl O. Thomas. *Phys. Rev. 76*, 308-9(1949) July 15 (Letter to the editor).

In investigating the scintillation properties of a series of structurally related organic crystals, i.e., 1,2-diphenylethane, 1,2-diphenylethylene (stilbene) and diphenylacetylene, it was found that diphenylacetylene possesses a much higher conversion efficiency (number of photons per unit α-particle energy loss) than any crystal previously reported. The curves showing the number of counts per minute as a function of the bias voltage indicate that the aforementioned crystal is six times as efficient as stilbene, which was formerly considered the most efficient known material for this purpose, Gittings et al, *Phys. Rev. 75*, 205(1949).

1297 Some statistical considerations on coincidence counting. Arthur Sard and R. D. Sard. *Rev. Sci. Instruments 20*, 526(1949) July (Laboratory and shop notes).

A means of estimating the number of chance-coincidences, or casuals, is applied and justified mathematically, assuming that the distributions of both the reals and the casuals is Poissonian and that the two distributions are independent.

1298 Equivalence theorems for meson-nucleon couplings. K. M. Case. *Phys. Rev. 76*, 14-17(1949) July 1.

The equivalence of pseudoscalar and pseudovector couplings of a pseudoscalar meson field with a nucleon field is examined. It is found that to the second order in the coupling constants the two couplings are equivalent except for two terms. One of these extra terms is predominantly an additional self-energy. The other occurs only for charged mesons and modifies the electromagnetic properties of a meson-nucleon system and the scattering of charged mesons. To this order (g^2) it does not contribute to nuclear forces. Similarly, it is shown that the vector coupling of scalar mesons to nucleons can be replaced (to g^2) by a term identical with the last of the above-mentioned terms. These results show that the delta-function interactions which have been found in the past are actually not present.

1299 The interaction representation of the Proca field. Frederik J. Belinfante. *Phys. Rev. 76*, 66-80(1949) July 1.

By means of an example it is shown that the methods used by Schwinger in quantum electrodynamics, *Phys. Rev. 74*, 1439(1948), can be generalized in such a way that they become applicable to meson theory. The method used seems slightly simpler than the method proposed by the Japanese school, *Prog. Theor. Phys. 1*, 27(1946) and *2*, 101(1947). It is found that the covariant field variables in interaction representation are not simply the transformed covariant variables of the Heisenberg representation. In addition it is found necessary to confine the space-like surfaces used in many applications to flat surfaces perpendicular to the time direction. The direct interaction between two particles through the meson field is obtained by a canonical transformation similar to the first approximation Schwinger transformation in quantum electrodynamics. The example of a neutral vector meson field discussed in the present paper has been chosen in such a way as to show the analogy to quantum electrodynamics. The interaction energy between particles obtained by Schwinger's relativistic treatment in meson theory (and also obtainable by the other usual perturbation methods) goes over into the Møller interaction for vanishing meson mass.

1300 Light scattering on a particle with a spin two. M. Ĭa. Sherobokov. *Zhur. Eksptl. i Teoret. Fiz. 19*, 473-80(1949) June (in Russian).

It is known that the effective cross section of certain particles for light scattering, even when calculated in the first non-vanishing approximation of the perturbation theory, grows indefinitely with the frequency of light. In order to account for this difficulty, Ginzburg, *Zhur. Eksptl. i Teoret. Fiz. 13*, 33(1943) and Heitler, et al, *Proc. Roy. Soc. (London) A, 176*, 368(1940), suggested the idea of excited spin states. Relativistic equations were found for particles with higher spins. However, no close investigation of the properties of such particles was made. In

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this respect only the work of Ginzburg, *Zhur. Eksptl. i Teoret. Fiz. 12*, 425(1942), may be cited, in which magnetic properties of a particle with a 3/2 spin are studied. The interest of such studies lies not only in the possibility of several variants of the theory, but also in the possible practical use of the equations for such particles; thus, the spin of mesons cannot be regarded as definitely established. The present work is an investigation of the scattering of light on particles with a spin two that are described by wave equations found by Fierz and Pauli, *Helv. Phys. Acta 12*, 3(1939); *Proc. Roy. Soc. (London) A, 173*, 211(1939). The rapid growth with increasing photon energy of the effective cross section for light scattering of a particle having a spin two can be explained by attributing to such a particle a kinetic moment of an order higher than that of a dipole.

1301 A method of approximations applied to wave equations of corpuscles endowed with intrinsic movement (spin), and a new semi-classical mechanics of such corpuscles. Bernard Kwal. *Compt. rend. 228*, 1634-6(1949) May 21 (in French).

Developing the discussion contained in *Compt. rend. 228*, 980(1949), the author attempts a method of approximations in order to obtain wave equations of spin-possessing particles. In the author's opinion the well known Pauli's method, *Helv. Phys. Acta 5*, 179(1932), is not adequately adaptable to the mathematical structure of wave equations of such particles. The more general formalism used here results in a semi-classical theory of corpuscles endowed with intrinsic movement. It cannot, however, be reduced to an ordinary mechanics of a material point having no intrinsic geometrical structure that could be described by Hamilton-Jacobi's equations with a scalar action function. The present theory introduces, apart from the scalar action relative to the external movement, certain tensorial actions relative to the intrinsic movement of the corpuscle.

1302 On a generalization of the lambda-limiting process and the non-uniqueness in the removal of divergence difficulties in the quantum theory of elementary particles. I. Pomeranchuk. *Phys. Rev. 76*, 298-9(1949) July 15.

A generalized process of the λ-limiting type is established, leading to the elimination of the divergences in the integrals of both the classical and quantum field theories. As a result, however, the process is not unique, and by a suitable choice of the convergence factor the observable quantities, such as the proper mass, may be given any finite value. This indicates either that limiting processes are not capable of solving the basic difficulties in the theory of fundamental particles, or that there is a necessity for additional postulates of the nature of selection rules.

1303 On Kramers' formula for the frequency distribution of the radiation emitted by an electron in a parabolic orbit. K. C. Westfold. *Phil. Mag. 40*, 698-703(1949) July.

It is shown that correction of Kramers' formula, *Phil. Mag. 46*, 836(1923), for emission during a free-free electron-ion encounter leads to a result which agrees with Gaunt's quantum-theory result for absorption by free electrons, *Phil. Trans. A, 229*, 163(1930), as required by the correspondence principle. The conditions under which Gaunt recovered Kramers' formula for emission in a parabolic orbit are not generally applicable. The correct formula for the absorption per unit intensity by free electrons of unit density also agrees with Gaunt's formula if the factor $\ln(mg^2d/Ze^2)$ be replaced by $\ln(mg^2/2hf)$, in which m is the electron mass, f the frequency, h is Planck's constant and g is the velocity of the electron liberated. There is the same relation between the classical and quantum formulas for the spontaneous emissivity.

1304 On the radius of the elementary particle. Hideki Yukawa. *Phys. Rev. 76*, 300-1(1949) July 15 (Letter to the editor).

The previous observation of Pais (private communication) that the theory of non-localizable fields can be applied to the particle with non-zero rest mass in the usual four-dimensional space, as well as in five-dimensional space, is extended. It is shown that the classical rigid sphere model for the electron, which has been believed to be much too classical for incorporation into the quantum theory of fields, can be reproduced as a very simple type of quantized non-localizable fields satisfying postulates of reciprococity. It is suggested that it might be possible to construct a consistent field theory on the model obtained using a formalism more or less similar to Heisenberg's S-matrix scheme.

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1305 On the relativistic interaction between particles and the quantum theory of fields. Jean G. Valatin. *Compt. rend. 228*, 1329-31(1949) Apr. 20 (in French).

The quantum-theoretical aspects of the problem of interaction of charged particles, which has been discussed in *Compt. rend. 228*, 1205(1949), are further studied here. Through a proper choice of factors in the energy operator, V corresponds only to the interaction of different particles, Jordan and Wigner, *Z. Physik 47*, 631(1928); Rosenfeld, *Z. Physik 73*, 253 (1931), so that the usual difficulties due to infinite proper energies do not arise.

1306 On the two-meson theory. Mituo Taketani, Seitaro Nakamura, Kenichi Ono, and Muneo Sasaki. *Phys. Rev. 76*, 60-3(1949) July 1.

The predictions of the two-meson theory as proposed by Marshak and Bethe, *Phys. Rev. 72*, 506(1947), and by Sakata, *Prog. Theo. Phys. 1*, 143(1946), are compared with experiments involving π- and μ-mesons. It is shown that the pair-type interaction between π-mesons and nucleons in the Marshak-Bethe theory does not agree with the frequent occurrence of stars produced by π-mesons, whereas the assumption in the Sakata theory that π-mesons with spin 0 or 1 are responsible for nuclear forces does. Although the smaller range for the nuclear forces thus obtained from the latter theory is not at variance with the hight energy neutron-proton scattering experiments, the deuteron quadrupole moment cannot be accounted for by a π-meson field alone, so that the admixture of another meson field with larger range is necessitated. Both π-μ-decay and μ-nuclear capture can be consistently accounted for by assuming spin 1/2 for μ-mesons as in the Sakata theory. However, nuclear β-decay and μ-β-decay have to be considered as direct processes as in Fermi's theory of β-decay, instead of indirect processes through virtual emission and absorption of π-mesons as is usually assumed in the meson theory.

1307 On the wave equation of a particle with a spin 1/2 in a field of a particle with a spin 1, and on a generalization of the gauge transformation of the first kind. Bernard Kwal. *Compt. rend. 228*, 980-1(1949) Mar. 21 (in French).

Attempts have been made recently to arrive at a better theory of the fine and hyperfine structures of hydrogen-like atoms, by endowing the electron with a supplementary magnetic moment; this leads to the introduction of a direct coupling with the Maxwell field in the Dirac equations. In the author's opinion, these attempts show that the theory of interactions between elementary charges requires the introduction of a complete photon field containing a greater number of components than that accepted by the classical Maxwell-Lorentz theory. The field of a particle with a spin 1 can be derived from a potential field of 15 components. The wave equations are given of a particle having a spin 1/2 in a field of a particle with a spin 1, and a generalization is presented of the gauge transformation of the field.

1308 Selected topics in elementary quantum mechanics. J. A. Spiers. National Research Council of Canada Report No. LT-20, Apr. 1949. 71p.

The following set of five lectures, originally given under the title of "Spin in Quantum Mechanics", is not intended to be a course of instruction, but rather to stimulate the interest and thought of the non-specialist. Particular stress is, therefore, laid on describing the technique actually employed in dealing with the more elementary concepts of present day quantum mechanics, and in relating them as far as possible to familiar ideas, The individual lectures are concerned with a survey of the general methods of calculation of quantum mechanics as applied to experiments on systems of elementary particles, the application of quantum mechanics to collision processes, solutions of the Schrodinger equation for a single particle in a central field of force, the properties of wave functions with respect to angular momentum, and the use of matrices.

1309 Wave equations in the de Sitter space. Satosi Watanabe. *Phys. Rev. 76*, 296-7(1949) July 15.

The quantum mechanics of fields and the general theory of relativity can be harmonized without interfering with the current principles of either theory as long as the gravitational force is not represented by the metric tensor, i.e., if the latter theory is applied to an empty, homogeneous space. The maximum unification of these two systems without a drastic alteration of their basic methods may, therefore, be attained by establishing a quantum theory of fields in the de Sitter space. A consistent method is introduced which permits a systematic reformulation of all the known field equations in the de Sitter frame of reference. The second-order wave equation

PHYSICS (continued)

$\partial^2 u/\partial x_i \partial x^i = 0$ in five-dimensional flat space can approximately reproduce the field hitherto considered in four-dimensional space, if a de Sitter space with the radius R is imbedded in the five-dimensional flat space and the derivative of the wave function u in the direction normal to this de Sitter space is assumed to be equal to imu, where m is a constant proper to the field. Conversely, the ordinary field equations in four-dimensional space can be regarded as valid only for a portion of de Sitter space with the linear dimension, which is small compared with the radius R of the universe. Extensions of these arguments to electromagnetic fields and spinor fields are also considered.

1310 Properties of some neutron-deficient cesium isotopes. Richard Walter Fink. AECU-394, July, 1949. 30p.

The discovery of two new neutron-deficient Cs isotopes, Cs^{127} and Cs^{129}, together with some observations on a 30-min Cs activity is reported. The radiation characteristics are reported:

Cs^{127}, half-life 5.5 ±0.5 1hr, positrons of maximum energy 1.2 Mev. Annihilation Radiation observed: 0.51 Mev gamma rays. Probable internal conversion electrons of energy 0.35 ± 0.05 Mev. Genetically produces Xe^{127} daughter. No harder gamma-rays.

Cs^{129}, half-life 31 ± 1 hr, no detectable positrons. K-capture. No hard gamma-rays, but probable emission of a 0.5 Mev gamma-ray. 0.35 ± 0.05 Mev conversion electrons.

Cs^{130}, half-life 30 min. K-capture. Emits 0.5 Mev gamma-ray. Mass number presumed from literature reference, and yields.

Proof for the genetic relationship $Cs^{127} \xrightarrow{\beta} Xe^{127}$ is given by both repurification experiments and direct-vacuum line isolation of the daughter radioxenon with identification of its 34-day half-life. Mass spectrograph proof for the mass assignments is given, showing that mass number 127 corresponds to the 5.5-hr positron-emitter and mass number 129 corresponds to the 31-hr K-capture Cs isotope.

1311 Coincidence and absorption investigation of the disintegration of Rh^{106}, Sb^{125}, and Pr^{142}. E. T. Jurney. *Phys. Rev.* 76, 290-2(1949) July 15.

The disintegration of Rh^{106}, Sb^{125}, and Pr^{142} has been studied with the help of conventional absorption and coincidence counting techniques. All three isotopes exhibit complex β-ray spectra, on the basis of the shapes of their β-γ-coincidence plots. A definite γ-γ-coincidence rate indicates cascades γ-rays in all the disintegration schemes. Corrections for coincidences between γ-rays and x-rays resulting from internal conversion are discussed for the case of Sb^{125}.

1312 Decay scheme of Ni^{65}. Kai Siegbahn and Amal Ghosh. *Phys. Rev.* 76, 307(1949) July 15 (Letter to the editor).

Some of the theoretical implications of the experiments previously reported by the authors, *Arkiv. Mat., Astron. Fysik 36A*, 19, in which data on the decay scheme of Ni^{65} was obtained using spectrometer and coincidence techniques, are discussed. A decay scheme is shown which is consistent with the observed β spectrum of three components with upper limits 0.60 Mev, 1.01 Mev, and 2.10 Mev and with relative abundances 29%, 14%, and 57%, respectively; and which also takes into account the emission of γ rays having energies of 0.37, 1.12, and 1.49 Mev. The selection rules, transition probabilities, and assignments of spin and parity are considered.

1313 The electron spectrum of Iodine^{131}. J. M. Cork, H. B. Keller, J. Sazynski, W. C. Rutledge and A. E. Stoddard. *Phys. Rev.* 75, 1621-2(1949) May 15 (Letter to the editor).

Recently obtained data on the conversion-electron spectrum from the γ radiation of I^{131} are given in tabular form; this isotope is of particular interest because of its extensive medical applications. The spectrum, which was obtained from carrier-free specimens, can be attributed to five γ-rays of energies 80.1, 163.6, 177.0, 284.1, and 364.2 Kev in addition to a higher energy line at 638 Kev which has been reported by Deutsch, *Phys. Rev.* 74, 1640(1948), and was observed with less accuracy by the authors by means of lead absorption measurements. A satisfactory level scheme is shown which includes the new lines.

1314 The half-life of C^{14}. R. C. Hawkings, R. F. Hunter, W. B. Mann, and W. H. Stevens. *Can. J. Research* 27, 545-54(1949) June (See also NSA 1-1321).

Compensated gas counters of known efficiency, filled with carbon disulfide and carbon dioxide containing a mass-spectrometrically determined proportion of $C^{14}O_2$, have been used to determine the half-life of C ^{14}. The half-life has been found to be 6360 ± 200 yr. 12 references, 4 figures, and 4 tables.

PHYSICS (continued)

1315 **Measurements on radioactive krypton isotopes from fission after mass-spectrographic separation.** J. Koch, O. Kofoed-Hansen, P. Kristensen, and W. Drost-Hansen. *Phys. Rev.* 76, 279-82(1949) July 15.

Radioactive isotopes of Kr resulting from fission of U have been separated in a mass spectrograph. The half-lives and the relative fission yields of the isotopes Kr^{85}, Kr^{87} and Kr^{88} have been measured, and the maximum energies of the β particles from Kr^{85} and Kr^{87} have been checked by absorption. It has been shown that Kr^{88} emits soft β particles and an intense γ radiation. This result, combined with other measurements, indicates that the β spectrum of Kr^{88} is complex.

1316 **Measurement of a 2.3 x 10^{-8}-second metastable state in Hg^{198}.** W. J. MacIntyre. *Phys. Rev.* 76, 312-3(1949) July 15 (Letter to the editor).

Using detectors and coincidence circuits of combined resolving time of 5.6 x 10^{-8} sec, states of β-γ-coincidences have been investigated in the region of (1-30) x 10^{-8} sec. A polystrene scintillation counter was used for γ-detection, in conjunction with a 931A and the usual circuits; this detector apparatus has a resolving time of 2.8 x 10^{-8} sec. For detection of the β-particles both proportional counters of resolving time of 2.8 x 10^{-8} sec and polystrene scintillation counters have been used. Curves are shown which indicate, for the case of β-γ-coincidences from Na^{24}, that the state of Mg^{24} has a half-life less than 2 x 10^{-8} sec. Evidence was also obtained for the existence of a metastable state of the Hg^{198}, formed in the decay of Au^{198}, which has a half-life of (2.3 ±0.2) x 10^{-8} sec. According to Segrè's formula, *Phys. Rev.* 60, 415(1941), and the data obtained, an electric quadrupole transition seems more probable than an electric octupole transition.

1317 **The nuclear spectra of Sb^{125}, Te^{125*}, Cr^{51}, and I^{131}.** Bernard D. Kern, Allan C. G. Mitchell, and Daniel J. Zaffarano. *Phys. Rev.* 76, 94-100(1949) July 1.

The nuclear spectra of Sb^{125}, Te^{125*}, Cr^{51}, and I^{131} have been measured with a magnetic lens spectrometer. Sb^{125} has a β-ray end-point at 0.621 Mev, a lower energy group at 0.288 Mev, and perhaps some groups of still lower energy. The γ-rays of Sb^{125} are at 0.125 (I.C.), 0.174 (I.C.), 0.431 (I.C.), 0.466, 0.609 (I.C.), and 0.646 Mev. (Those marked with the notation (I.C.) are internally converted.) The metastable state of Te^{125}, daughter of Sb^{125}, is characterized by the emission of an internally converted γ-ray of energy 0.110 Mev. The experiments indicated that Cr^{51} does not emit positrons but decays by K-capture accompanied by two γ-rays of energies 0.323 and 0.267 Mev, the latter being entirely internally converted. It is noted that I^{131} has a β-ray end point of 0.605 Mev with a lower energy group at 0.250 Mev and γ-rays at 0.080, 0.282, 0.363, and 0.637 Mev are observed. The disintegration schemes of Sb^{125}, Te^{125*}, and I^{131} are discussed.